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Line Oriented Flight Scenarios for Synthetic Vision Systems (SVS)

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Overview

NASA's Concept of Operations for Commercial and Business Aircraft Synthetic Visions Systems (CONOPS) report outlines many of the anticipated benefits envisioned for operators and air traffic managers in a future SVS equipped environment. Among them are increased operational safety, enhanced air traffic management and improved pilot situation awareness in low visibility conditions. In order to insure that ongoing research and development of SVS takes into account the actual conditions faced today by professional pilots, as well as explore futures possibilities, SA Technologies was tasked to develop what is known within the commercial aviation training community as line oriented operational scenarios that mirror, as closely as possible, the current operating environment faced today by commercial and business aircraft pilots.

Over the last decade Line Oriented Flight Training (LOFT) and Line Oriented Evaluations (LOE) have become the standard mechanism for commercial aviation training organizations to train and evaluate their pilots. The goal of LOFT and LOE is to construct operational scenarios that closely mirror the actual environments and situations that pilots face during real world flights. The high fidelity and realism of these scenarios place the pilots mentally within the world they experience every day , and has proven to be an effect method of evaluating their knowledge and performance and transferring that knowledge to the deployment of new technologies and systems. It is also an excellent method for developing and testing future aircraft technologies. Because highly experienced pilots bring a wealth of experience and knowledge to any technology evaluation process, it is important that the test subjects be able to conduct themselves as normally as possible when evaluating new or novel technologies. That is the goal of the scenarios developed for this effort. They can be considered as Line Oriented Test Scenarios (LOTS), which build on the experiences gained in the LOFT/LOE development process.

LOFT/LOE/LOTS development is a very time intensive, complex process that requires a deep understanding of the operational environment that pilots face on a daily basis. The degree of fidelity in each scenario must be very high in order to get the most benefit from the process. Because experienced airline and business aircraft pilots have a deeply embedded mental model of the world they operate in, even minor discrepancies or oversights in scenarios can disrupt their situation awareness and decision making, leading them to take actions or make decisions that they would normally not do in an actual aircraft. Such changes in normal behavior might be detrimental to researchers or systems designers who are attempting to determine if SVS technologies enhance or detract from current systems now deployed on CaB aircraft.

The scenarios presented in this report focus on replicating the existing operational environment as closely as possible. The goal is to give researchers and systems engineers

high confidence that when they test various SVS technology configurations, any observable changes in pilot behavior can be attributed to the technology, rather than to the simulated environment.

Line Oriented Test Scenarios

Overall, twelve scenarios are presented here.

- A - Station Keeping on Closely Spaced Parallel Approach
- B - Flight Path Intrusion on Closely Spaced Parallel Approach
- C - Land and Hold Short Operations (LASHO)
- D - Station Keeping on Closely Spaced Parallel Approach, Runway Incursion During Landing- Go-Around

- E - Taxi and Visual Separation on Takeoff
- F - Taxi, Runway Incursion and Departure Conflict
- G - Flight into Terrain during Arrival Vectoring
- H - Flight into Terrain during Departure Vectoring

- I - GA Traffic Pattern Entry and Landing in Challenging Terrain – Eagle Vail
- J - GA Ground Operations, Taxi and Departure
- K - GA Traffic Pattern Entry and Landing in Challenging Terrain - Asheville
- L - GA Terrain Avoidance Equivalent to VMC

The initial four scenarios presented in this report focus on what can be considered a routine operating environment centered on the already robust SVS database of the Dallas-Ft. Worth (DFW) airport (an operational environment featuring primarily flat terrain). Because DFW has multiple parallel and intersecting runway configurations, a well established Land and Hold Short (LASHO) program, and lacks high terrain, it is an excellent airport to test many of the anticipated profiles and uses of SVS. Among them (as outlined in the CONOPS report) are:

- Hazard Avoidance
- Self Separation
- Emergency Management
- Improved Operational Capability/Pilot Aids/Enhanced Flight Management
- Navigation

The scenarios presented are based on taking advantage of DFW's runway and taxiway configurations to test many of the SVS concepts with a minimum of variation for the test subjects, experimenters and programmers.

The second four scenarios focus on ground movement, departure procedures and non-normal operations. The first two (Scenarios E and F) take place at DFW. The second two (Scenarios G and H) take place at and around Las Vegas, Nevada. Aspects of SVS included in these scenarios include:

- Taxi and Visual Separation on Takeoff
- Runway Incursion and Departure Conflict
- Decent into Terrain during Approach Vectoring
- Decent into Terrain during Departure Vectoring

The final four scenarios are for experimentation involving general aviation (GA) aircraft. Two of the scenarios involve a GA aircraft operating into airports with challenging terrain (Eagle-Vail, CO and Asheville, NC). The other two require the GA aircraft to operate in high density ground and airport traffic situations at Washington-Reagan Airport and Asheville, NC.

The experiment designers may choose whether to use the actual approaches for DFW or de-identify the airport, it's approach fixes and navigation aids (so as not to cue pilots to expect "normal" operations at these airports). In order to make the LOFT construction process more efficient, the actual runways, taxiways, approaches fixes and navigation aids from DFW are included in each scenario. NASA may, at its option, easily disguise the DFW facility in implementation of these scenarios.

Accompanying each scenario is a Microsoft Powerpoint™ (PPT) file and a table of aircraft data. The Powerpoint™ file gives an overview of the type of SVS application that the researcher may be interested in testing and the corresponding table gives the programmer an outline of the aircraft's location, altitude, heading, speed and configuration and timing sequence. It also includes the radio calls, wind speed and wind direction. Additionally, an ATC script is provided that the researcher can use to insure that the highest degree of fidelity is maintained.

Each of the scenarios will be described separately, along with critical measures for evaluating the performance and situation awareness of the test subjects. The scenarios have each been designed to test important features of the SVS concept within critical operational contexts. The scenarios may be employed with various SVS display concepts and characteristics, or may be employed with a baseline (current day) system.

Line Oriented Evaluation Scenario A

Station Keeping on Closely Spaced Parallel Approach

SVS Aspects Tested: The following CaB SVS CONOPS applications are tested in this scenario.

Approach Phase

- Self Separation:
  - A-7 De-Conflict Approaches
  - A-8 Identify Traffic Ahead
  - A-9 Self Separation
  - A-12 Closely Spaced Parallel Approaches
  - A-14 Station Keeping

Time: 22 minutes

This scenario tests the ability of the subject to develop and maintain general situation awareness of multiple aircraft during a normal approach and landing. The scenario is constructed such that the sequence of each aircraft is one minute spacing (approximately 3 miles) from the aircraft ahead during the final approach phase and two minute spacing on the aircraft ahead that is landing on the same runway. In addition to the test subjects aircraft (NASA 123) there are four other aircraft in the pattern, three which will be ahead of NASA 123 and one behind. One aircraft (American 696) is two minutes directly ahead of NASA 123 and both aircraft are being vectored for approach to Rwy 18R at DFW. Three aircraft (two ahead, the one behind) are landing on the adjacent runway, 18L and are arriving from the opposite (east) side of the airport from NASA 123.

The scenario starts with NASA 123 on the west side of DFW, level at 11,000 feet and northbound on downwind for Rwy 18R. Radio traffic indicates that four other aircraft are in the pattern. The scenario continues as each aircraft is sequenced into a single final approach corridor to cross HASTY final approach fix at one minute intervals. This scenario would be not be realistic in the current ATC environment.

SA Measurement

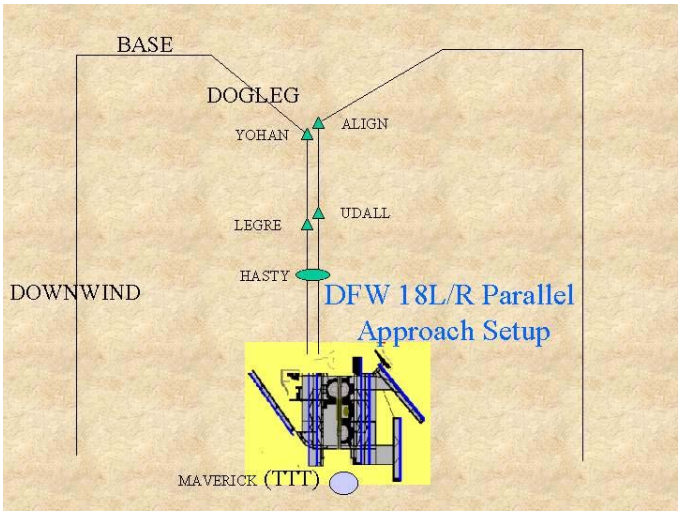
(1) Flight path adherence – The ability of the pilot to adhere to the desired flight path should be measured. This would include ability to maintain the required spacing from other aircraft, adherence to ATC commands, and deviations from glide slope.

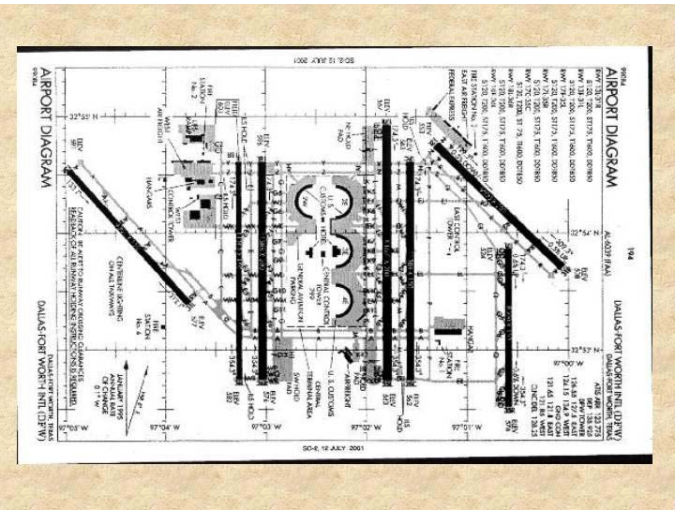
(2) SAGAT – The SA of the pilot should be measured via SAGAT queries at 3 different freeze points (at times 3.55, 10.79, and 15.54). Queries should include:

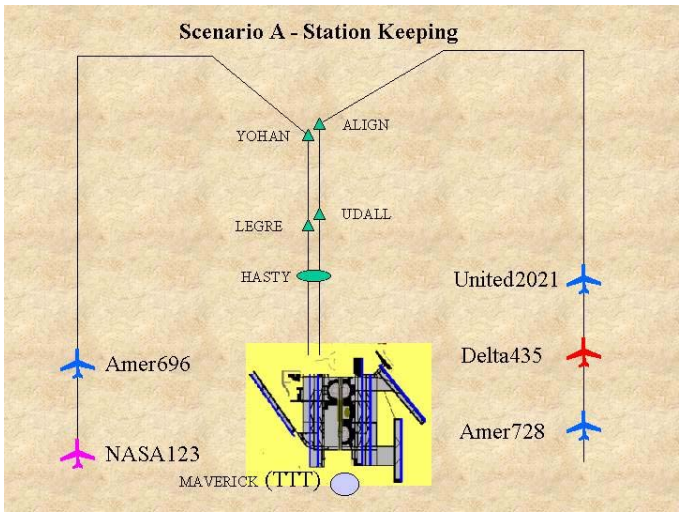
- Query 1 What is the current heading of your aircraft?
- Query 2 What is the current altitude (MSL) of your aircraft?
- Query 3 What is the indicated airspeed of your aircraft?
- Query 4 What is the current rate of climb/descent of your aircraft?
- Query 5 What is the attitude of your aircraft (pitch and bank)?
- Query 6 What are your current settings (flaps, slats, gear, speed brakes)?
- Query 7 How much fuel do you currently have?
- Query 8 What are the current winds (direction, magnitude, gusting to)?
- Query 14 Are you in conformance with your current clearance for this phase of flight?
- Query 15 Is there any conflicting traffic on your current (projected) flight path?
- Query 16 Conflicting traffic is currently located at (bearing and miles)?
- Query 17 Traffic Conflict Type
- Query 18 Is a change in path or altitude needed to avoid obstacles or terrain?
- Query 24 Are your systems correctly set-up for this phase of flight?
- Query 27 Are you on the proper glide path?
- Query 28 Where on the runway do you think you will touch down?
- Query 29 Where on the runway do you think you will stop the aircraft? (last stop only)
- Query 30 How far to the destination airport along your planned route of flight?
- Query 31 What is your current rate of closure on the aircraft in front of you?
- Query 32 How far to your next waypoint?

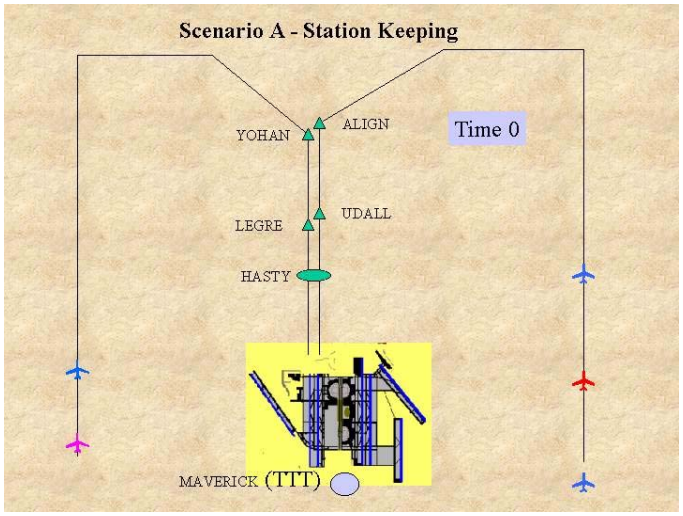
Scenarios for Assessing the Utility of Synthetic Visual Systems (SVS) in Commercial and Business (CaB) Aircraft

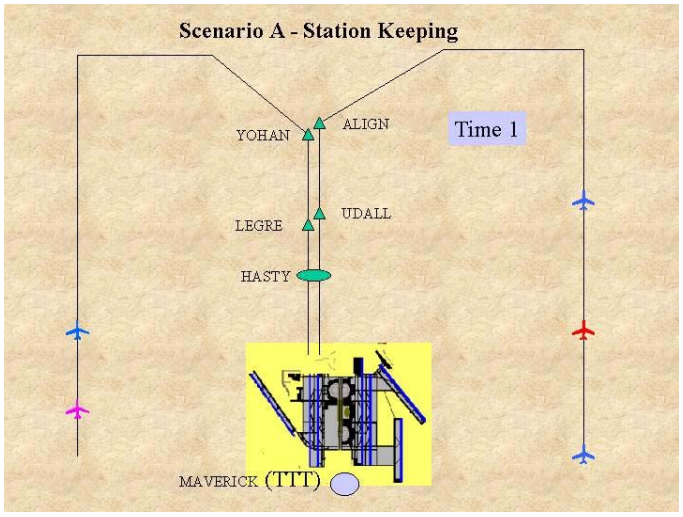
Scenario A - Station Keeping

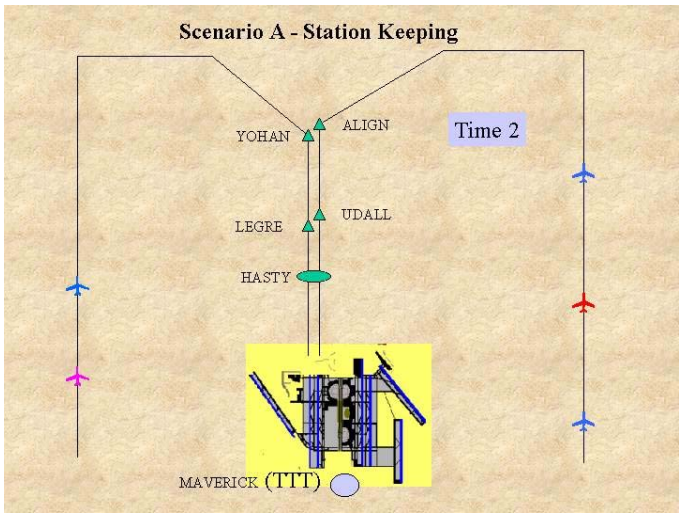


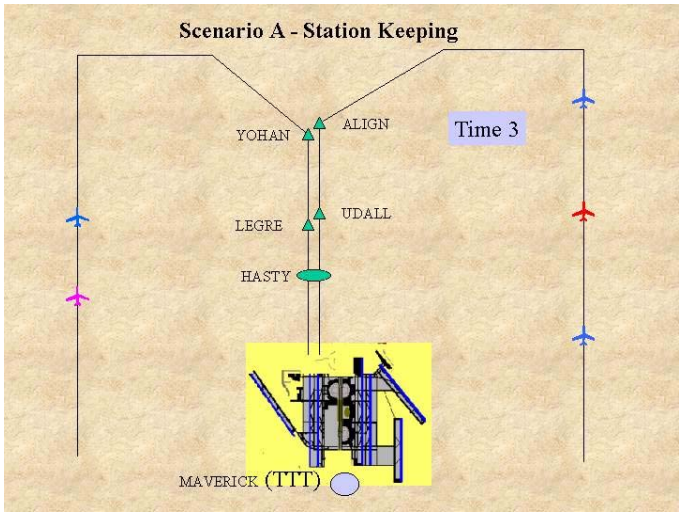


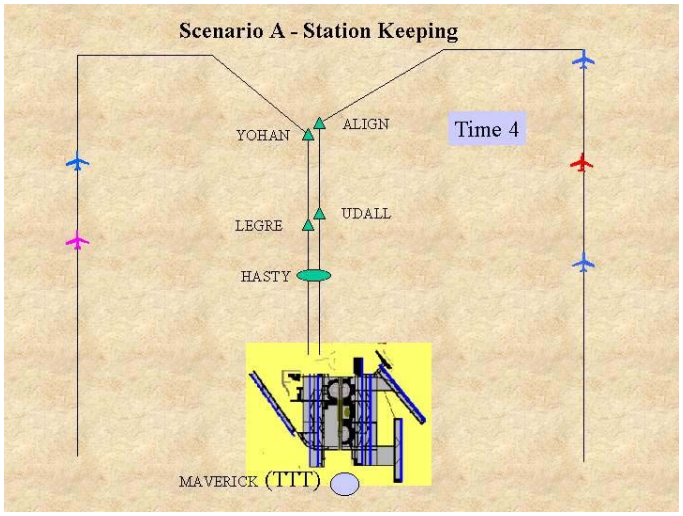

Scenario A - Station Keeping
YOHAN
ALIGN
LEGRE
UDALL
HASTY
United2021
Amer696
Delta435
Amer728
NASA123
MAVERICK (TTT)

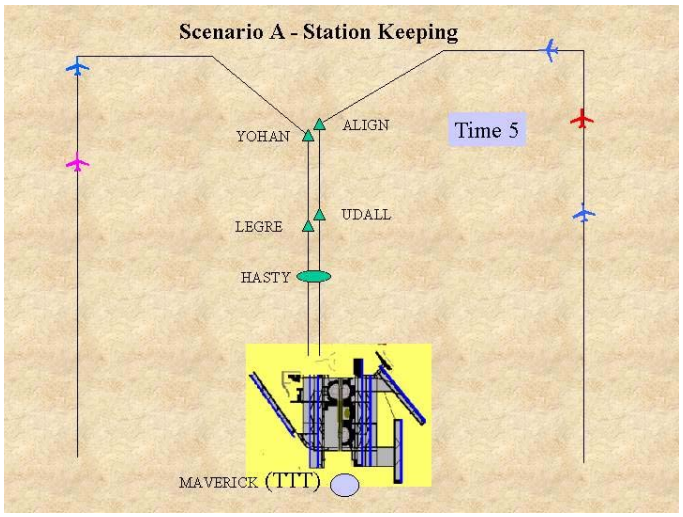

Scenario A - Station Keeping
YOHAN
ALIGN
Time 0
LEGRE
UDALL
HASTY
MAVERICK (TTT)

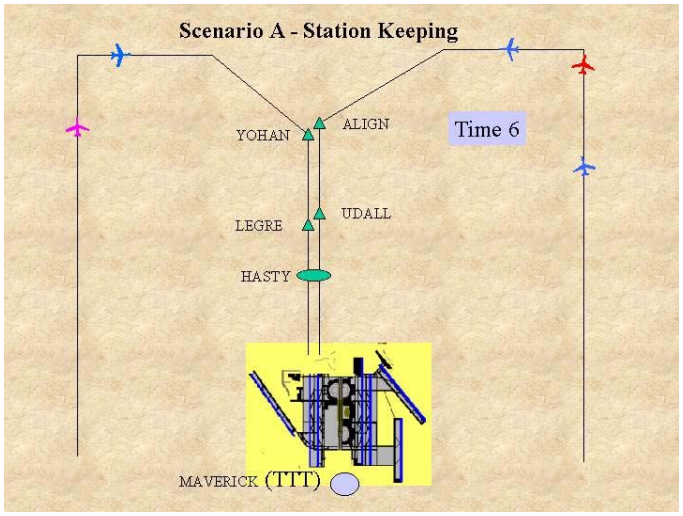

Scenario A - Station Keeping
YOHAN
ALIGN
Time 1
LEGRE
UDALL
HASTY
MAVERICK (TTT)

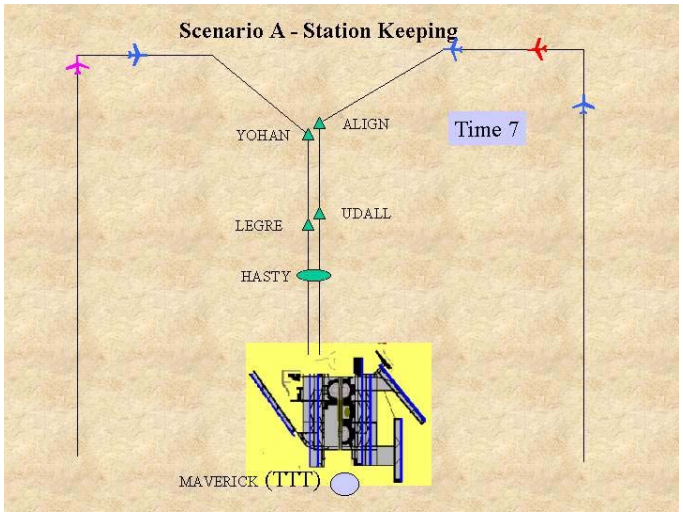

Scenario A - Station Keeping
YOHAN
ALIGN
Time 2
LEGRE
UDALL
HASTY
MAVERICK (TTT)

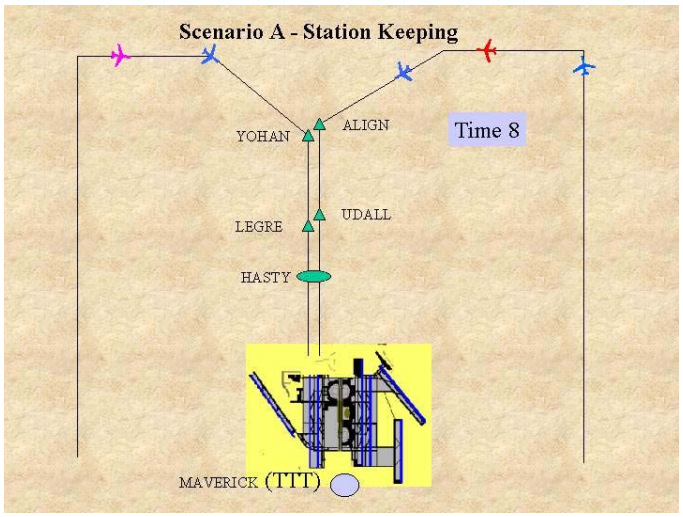

Scenario A - Station Keeping
YOHAN
ALIGN
Time 3
LEGRE
UDALL
HASTY
MAVERICK (TTT)

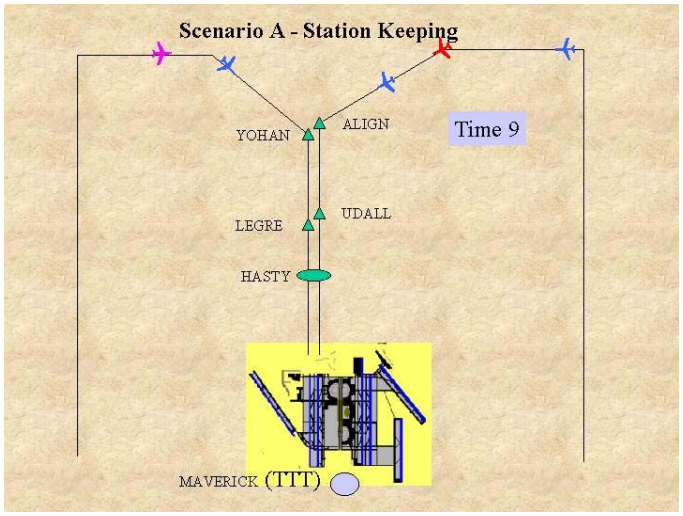

Scenario A - Station Keeping
YOHAN
ALIGN
Time 4
LEGRE
UDALL
HASTY
MAVERICK (TTT)

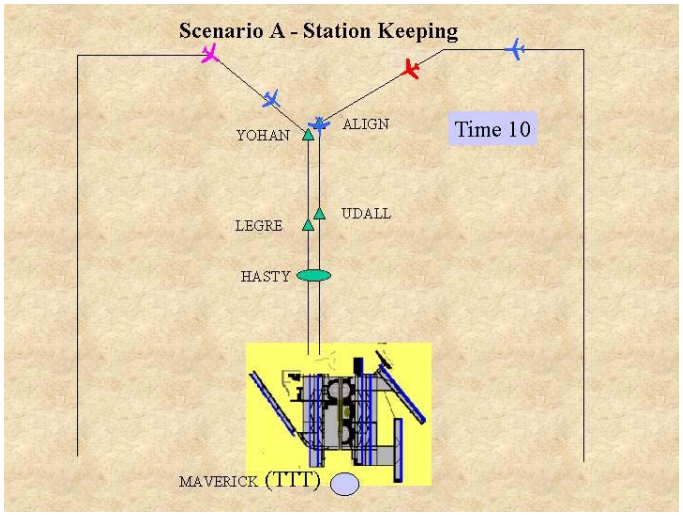

Scenario A - Station Keeping
YOHAN
ALIGN
Time 5
LEGRE
UDALL
HASTY
MAVERICK (TTT)

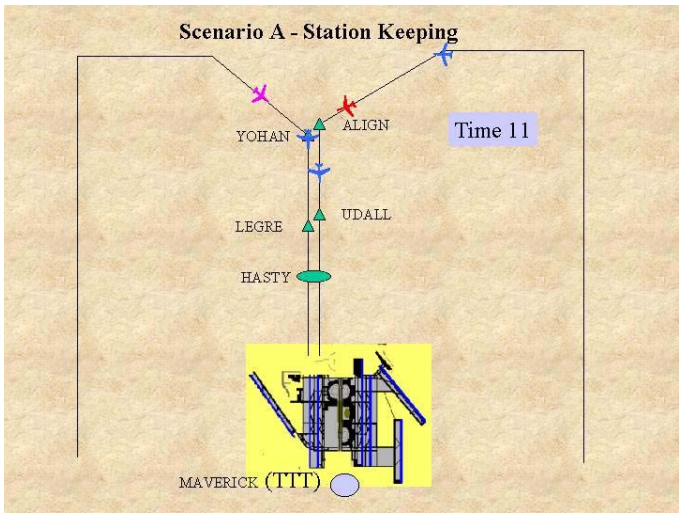

Scenario A - Station Keeping
YOHAN
ALIGN
Time 6
LEGRE
UDALL
HASTY
MAVERICK (TTT)

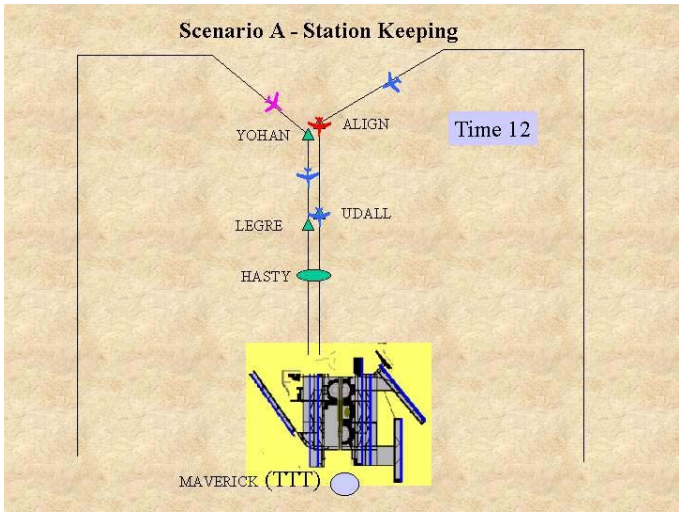

Scenario A - Station Keeping
YOHAN
ALIGN
Time 7
LEGRE
UDALL
HASTY
MAVERICK (TTT)

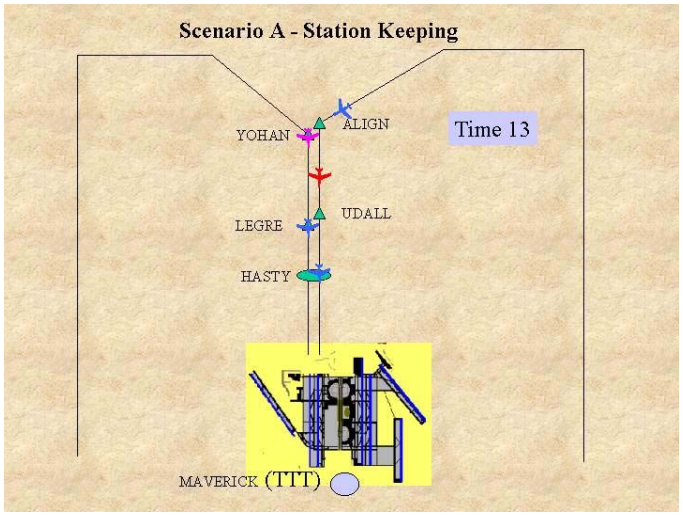

Scenario A - Station Keeping
YOHAN
ALIGN
Time 8
LEGRE
UDALL
HASTY
MAVERICK (TTT)

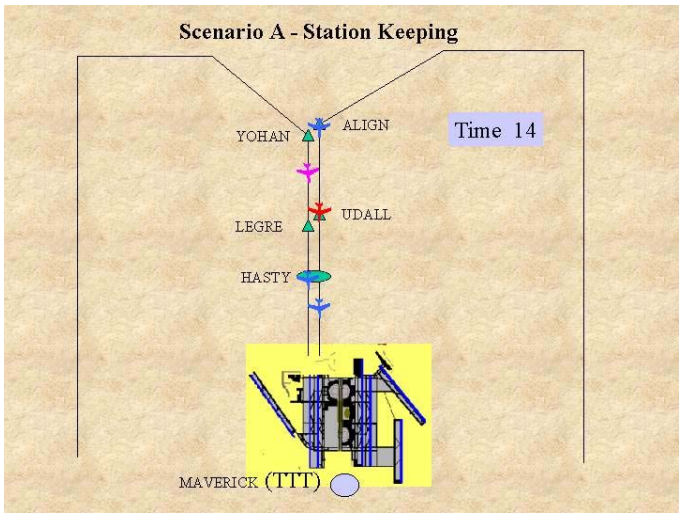

Scenario A - Station Keeping
YOHAN
ALIGN
Time 9
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Scenario A - Station Keeping
YOHAN
ALIGN
Time 10
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Scenario A - Station Keeping
YOHAN
ALIGN
Time 11
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Scenario A - Station Keeping
YOHAN
ALIGN
Time 12
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Scenario A - Station Keeping
YOHAN
ALIGN
Time 13
LEGRE
UDALL
HASTY
MAVERICK (TTT)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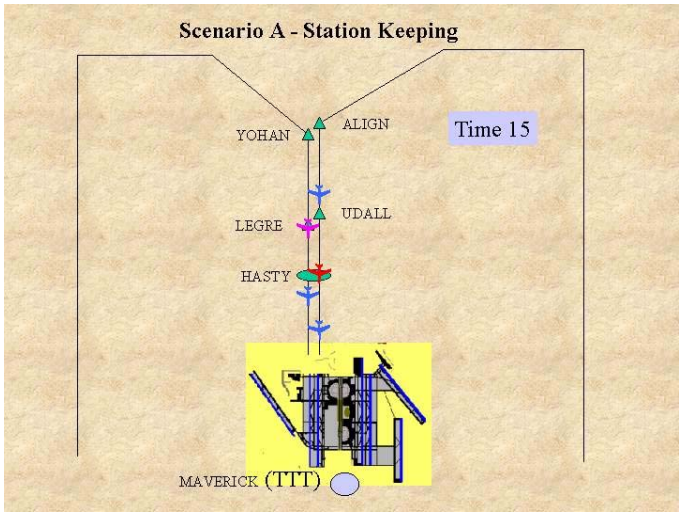
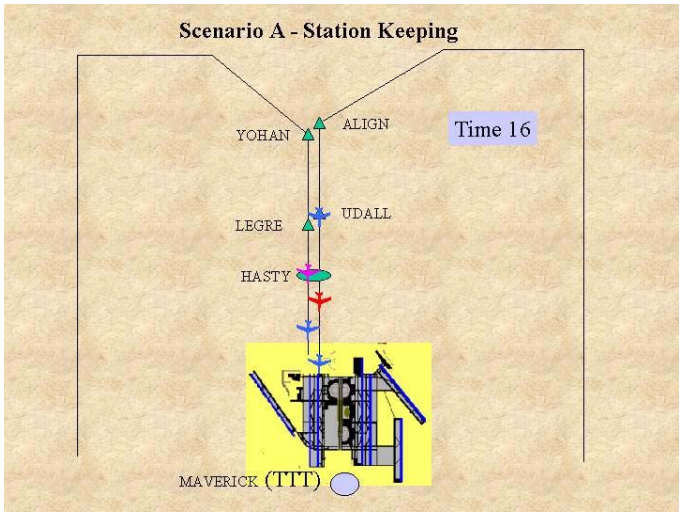
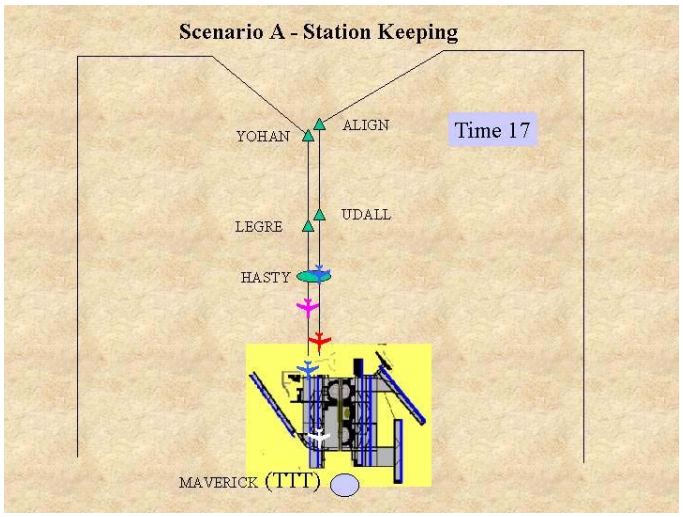
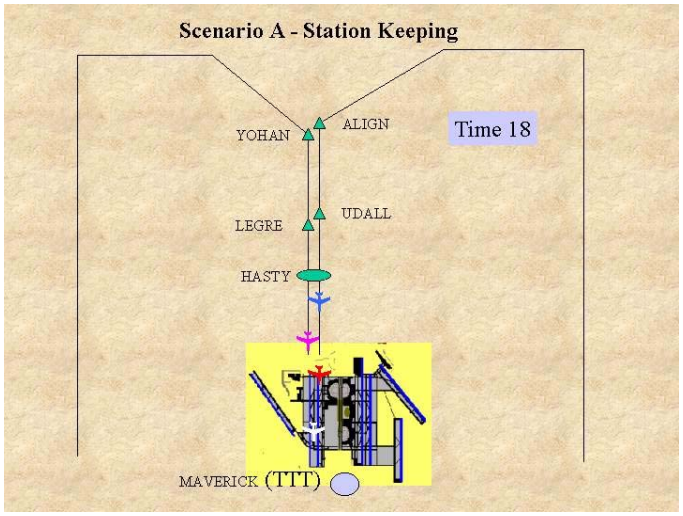
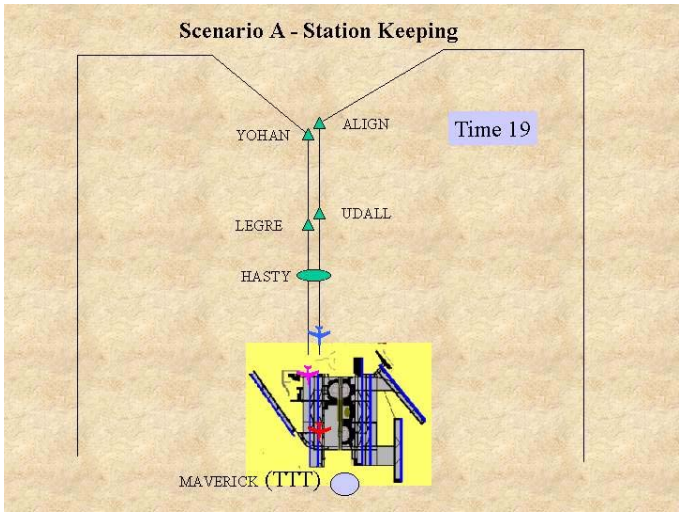
YOHAN
ALIGN
Time 14
LEGRE
UDALL
HASTY
MAVERICK (TTT)

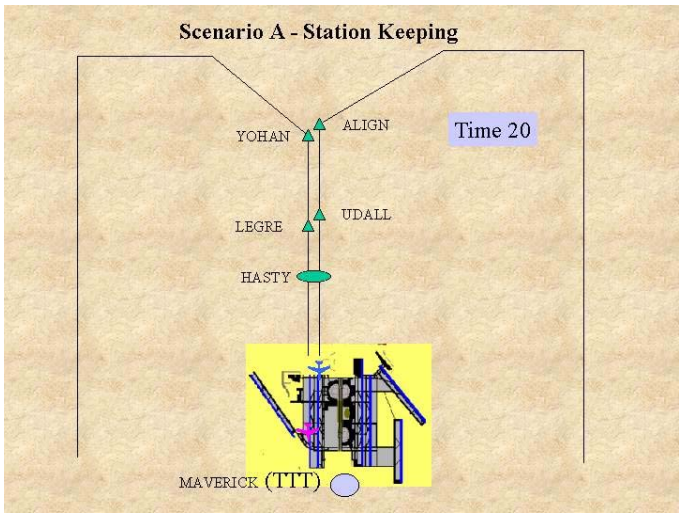

Scenario A - Station Keeping
YOHAN
ALIGN
Time 15
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Scenario A - Station Keeping
YOHAN
ALIGN
Time 16
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Scenario A - Station Keeping
YOHAN
ALIGN
Time 17
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Scenario A - Station Keeping
YOHAN
ALIGN
Time 18
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Scenario A - Station Keeping
YOHAN
ALIGN
Time 19
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Scenario A - Station Keeping
YOHAN
ALIGN
Time 20
LEGRE
UDALL
HASTY
MAVERICK (TTT)

Scenario A - Aircraft Data Files

NASA123

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
1	downwind		360	250	U	U	175	0
2	downwind	8000	360	250	U	U	175	0
3	downwind		360	250	U	U	175	0
4	downwind	7000	360	250	U	U	175	0
5	downwind		360	250	U	U	175	0
6	downwind	6000	360	250	U	U	175	0
7	downwind		360	230	U	U	175	0
8	turn to base	5000	360	210	U	U	175	0
9	base	5000	090	210	U	U	175	0
10	base	5000	090	210	U	U	175	0
11	turn to DL	5000	090	210	U	U	175	0
12	DL	3000	140	210	U	U	175	0
13	DL	3000	140	210	U	U	175	0
14	YOHAN	3000	175	210	U	U	175	0
15		3000	175	195	5	U	175	0
16	LEGRE	3000	175	180	15	U	175	0
17	HASTY	2400	175	180	15	U	175	0
18							175	0
19							175	0
20	touchdown	603	175	120	30	D	175	0
21	end of rwy	603	175	0	30	D	175	0

Time	Radio Traffic
0	
1	NASA123 - decend to 5000 ft
2	
3	
4	
5	
6	
7	NASA123 - turn rt hdg 090, maintain 210 kts
8	
9	
10	NASA123 - turn rt hdg 140, decend to 3000 ft
11	NASA123 - traffic 11 oclock, 3 miles
12	NASA123 - maintain visual seperation from that traffic
13	NASA123 - turn rt hdg 175, maintain 180 kts to the marker,
14	NASA123 cleared for the ILS app rwy 18R, tower now on 124.15
15	
16	NASA123, cleared to land
17	
18	
19	
20	NASA123, hold short runway 18L

Amer696

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	downwind	8000	360	250	U	U	175	0
1	downwind		360	250	U	U	175	0
2	downwind	8000	360	250	U	U	175	0
3	downwind		360	250	U	U	175	0
4	downwind	6000	360	250	U	U	175	0
5	downwind		360	230	U	U	175	0
6	turn to base	5000	360	210	U	U	175	0
7	base	5000	090	210	U	U	175	0
8	base	5000	090	210	U	U	175	0
9	turn to DL	5000	090	210	U	U	175	0
10	DL	3000	140	210	U	U	175	0
11	DL	3000	140	210	U	U	175	0
12	YOHAN	3000	175	210	U	U	175	0
13		3000	175	195	5	U	175	0
14	LEGRE	3000	175	180	15	U	175	0
15	HASTY	2400	175	180	15	U	175	0
16							175	0
17							175	0
18	touchdown	603	175	120	30	D	175	0
19	end of rwy	603	175	0	30	D	175	0

Time	Radio Traffic
0	Amer696 - decend to 5000 ft
1	
2	
3	
4	
5	Amer696 - turn rt hdg 090, maintain 210 kts
6	
7	
8	Amer696 - turn rt hdg 140, decend to 3000 ft
9	Amer696 - traffic 11 oclock, 3 miles
10	Amer696 - maintain visual seperation from that traffic
11	Amer696 - turn rt hdg 175, maintain 180 kts to the marker.
12	Amer696, cleared for the ILS app rwy 18r, tower now on 124.15
13	
14	Amer696, cleared to land
15	
16	
17	
21	Amer696, hold short runway 18L

United2021

	location	alftitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	downwind		360	250	U	U	175	0
1	downwind	7000	360	250	U	U	175	0
2	downwind		360	250	U	U	175	0
3	downwind	6000	360	250	U	U	175	0
4	downwind		360	230	U	U	175	0
5	turn to base	5000	360	210	U	U	175	0
6	base	5000	270	210	U	U	175	0
7	base	5000	270	210	U	U	175	0
8	turn to DL	5000	270	210	U	U	175	0
9	DL	3000	220	210	U	U	175	0
10	DL	3000	220	210	U	U	175	0
11	ALIGN	3000	175	210	U	U	175	0
12		3000	175	195	5	U	175	0
13	UDALL	3000	175	180	15	U	175	0
14	HASTY	2300	175	180	15	U	175	0
15							175	0
16							175	0
17	touchdown	603	175	120	30	D	175	0
18	end of rwy	603	175	0	30	D	175	0

Time	Radio Traffic
0	
1	
2	
3	
4	United2021 - turn lft hdg 270, maintain 210 kts
5	
6	
7	United2021 - turn lft hdg 220, decend to 3000 ft
8	
9	
10	United2021 - turn lft hdg 175, maintain 180 kts to the marker.
11	United2021, cleared for the ILS app rwy 18L, tower now on 124.15
12	
13	United2021, cleared to land
14	
15	
16	
17	United2021, contact gnd

Delta435

	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	downwind		360	250	U	U	175	0
1	downwind	8000	360	250	U	U	175	0
2	downwind		360	250	U	U	175	0
3	downwind	7000	360	250	U	U	175	0
4	downwind		360	250	U	U	175	0
5	downwind	6000	360	250	U	U	175	0
6	downwind		360	230	U	U	175	0
7	turn to base	5000	360	210	U	U	175	0
8	base	5000	270	210	U	U	175	0
9	base	5000	270	210	U	U	175	0
10	turn to DL	5000	270	210	U	U	175	0
11	DL	3000	220	210	U	U	175	0
12	DL	3000	220	210	U	U	175	0
13	ALIGN	3000	175	210	U	U	175	0
14		3000	175	195	5	U	175	0
15	UDALL	3000	175	180	15	U	175	0
16	HASTY	2300	175	180	15	U	175	0
17							175	0
18							175	0
19	touchdown	603	175	120	30	D	175	0
20	end of rwy	603	175	0	30	D	175	0

Time	Radio Traffic
0	Delta435 - decend to 5000 ft
1	
2	
3	
4	
5	
6	Delta435 - turn lft hdg 270, maintain 210 kts
7	
8	
9	Delta435 - turn lft hdg 220, decend to 3000 ft
10	delta435 - traffic 1 oclock, 3 miles
11	delta435 - maintain visual seperation from that traffic
12	Delta435 - turn lft hdg 175, maintain 180 kts to the marker.
13	Delta435, cleared for the ILS app rwy 18L, tower now on 124.15
14	
15	Delta435, cleared to land
16	
17	
18	
19	Delta435, contact gnd

Amer728

	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
2	downwind		360	250	U	U	175	0
3	downwind	8000	360	250	U	U	175	0
4	downwind		360	250	U	U	175	0
5	downwind	7000	360	250	U	U	175	0
6	downwind		360	250	U	U	175	0
7	downwind	6000	360	250	U	U	175	0
8	downwind		360	230	U	U	175	0
9	turn to base	5000	360	210	U	U	175	0
10	base	5000	270	210	U	U	175	0
11	base	5000	270	210	U	U	175	0
12	turn to DL	5000	270	210	U	U	175	0
13	DL	3000	220	210	U	U	175	0
14	DL	3000	220	210	U	U	175	0
15	ALIGN	3000	175	210	U	U	175	0
16		3000	175	195	5	U	175	0
17	UDALL	3000	175	180	15	U	175	0
18	HASTY	2300	175	180	15	U	175	0
19							175	0
20							175	0
21	touchdown	603	175	120	30	D	175	0
22	end of rwy	603	175	0	30	D	175	0

Time	Radio Traffic
2	Amer728 - decend to 5000 ft
3	
4	
5	
6	
7	
8	Amer728 - turn lft hdg 270, maintain 210 kts
9	
10	
11	Amer728 - turn lft hdg 210, decend to 3000 ft
12	Amer728 - traffic 1 oclock, 3 miles
13	Amer728 - maintain visual seperation from that traffic
14	Amer728 - turn lft hdg 175, maintain 180 kts to the marker
15	Amer728, cleared for the ILS app rwy 18L, tower now on 124.15
16	
17	Amer728, cleared to land
18	
19	
20	
21	Amer728, contact gnd

ATC Master Communication Log- Scenario A

Air Traffic Controller Radio Communications

Scripted Radio Calls from Other Aircraft

NASA 123 Radio Suggested Radio Calls

Time 0

American 696, level at 11000 ft.
Hello Amer696 - descend to 5000 ft
American 696, descending to 5000 ft

DFW approach, Delta 435
Delta435, Roger
Delta435 - descend to 5000 ft
5000 ft, Delta 435

Time 1

Approach, NASA 123, 11000 ft.
NASA123 - descend to 5000 ft
(Read back clearance)

Time 2

American 728 checking in
Roger Amer728
Amer728 - descend to 5000 ft
(Read back clearance)

Time 3

Time 4

United2021 - turn left hdg 270, maintain 210 kts
(Read back clearance)

Time 5

Amer696 - turn right hdg 090, maintain 210 kts
(Read back clearance)

Time 6

Delta435 - turn left hdg 270, maintain 210 kts
(Read back clearance)

Time 7

United2021 - turn left hdg 210, descend to 3000 ft
(Read back clearance)
NASA123 - turn right hdg 090, maintain 210 kts
(Read back clearance)

Time 8

Amer696 - turn right hdg 140, descend to 3000 ft
(Read back clearance)
Amer728 - turn left hdg 270, maintain 210 kts
(Read back clearance)

Time 9

Delta435 - turn left hdg 210, descend to 3000 ft
(Read back clearance)
Amer696 - traffic 11 o'clock, 3 miles
Roger, Amer696 Looking…

Time 10

Delta435 - traffic 1 o'clock, 3 miles
Roger, Delta435 Looking…
United2021 - turn left hdg 175, maintain 180 kts to the marker, cleared for the ILS app rwy 18L, tower now on 124.15
(Read back clearance)
Amer696, traffic in sight
Roger Amer696 - maintain visual separation from that traffic
NASA123 - turn right hdg 140, descend to 3000 ft
(Read back clearance)

Time 11

Amer728 - turn left hdg 210, descend to 3000 ft
(Read back clearance)
Amer696 - turn right hdg 175, maintain 180 kts to the marker, cleared for the ILS app rwy 18r, tower now on 124.15
(Read back clearance)
NASA123 - traffic 11 o'clock, 3 miles
Subject to call traffic in sight
Amer696, cleared to land

(Read back clearance)
Delta435, traffic in sight
Roger, Delta435, maintain visual separation from that traffic, he's for the left side

Time 12

Delta435 - turn left hdg 175, maintain 180 kts to the marker, cleared for the ILS app rwy 18L, tower now on 124.15
(Read back clearance)
NASA123 - maintain visual separation from that traffic
(Read back clearance)
Amer728 - traffic 1 o'clock, 3 miles
Amer728 - looking

Time 13

United2021, cleared to land
(Read back clearance)
NASA123 - turn right hdg 175, maintain 180 kts to the marker, cleared for the ILS app rwy 18r, tower now on 124.15
(Read back clearance)
Amer728, traffic in sight
Roger Amer728 - maintain visual separation from that traffic

Time 14

Amer728 - turn left hdg 175, maintain 180 kts to the marker, cleared for the ILS app rwy 18L, tower now on 124.15
(Read back clearance)
Amer696, cleared to land
(Read back clearance)

Time 15

Delta435, cleared to land
(Read back clearance)

Time 16

NASA123, cleared to land
(Read back clearance)

Time 17

Amer728, cleared to land
(Read back clearance)
United2021, contact ground
(Read back clearance)

Time 18

Amer696, hold short runway 18L
(Read back clearance)

Time 19

Delta435, contact ground
(Read back clearance)

Time 20

NASA123, hold short runway 18L
(Read back clearance)

Time 21

Amer728, contact ground
(Read back clearance)

Line Oriented Evaluation Scenario B

Flight Path Intrusion on Closely Spaced Parallel Approach

SVS Aspects Tested: The following CaB SVS CONOPS applications are tested in this scenario.

Approach Phase

- Self Separation:
  - A-7 De-Conflict Approaches
  - A-8 Identify Traffic Ahead
  - A-9 Self Separation
  - A-12 Closely Spaced Parallel Approaches
  - A-14 Station Keeping

Time: 12 minutes

The scenario starts with NASA 123 on the west side of DFW, level at 11,000 feet and northbound on downwind for Rwy 18R. Radio traffic indicates that four other aircraft are in the pattern. The scenario continues as each aircraft is sequenced into a single final approach corridor to cross HASTY final approach fix at one minute intervals. This scenario would not be realistic in the current ATC environment.

This scenario tests the ability of the subject to detect a flight path intrusion by another aircraft during a normal approach and landing sequence. The scenario is constructed such that the sequence of each aircraft is one minute spacing (approximately 3 miles) from the aircraft ahead during the final approach phase and two minute spacing on the aircraft ahead that is landing on the same runway. In addition to the test subjects aircraft (NASA 123) there are four other aircraft in the pattern, three which will be ahead of NASA 123 and one behind. One aircraft (USAir 298) is two minutes directly ahead of NASA 123 and both aircraft are being vectored for approach to Rwy 18R at DFW. Three aircraft (two ahead, the one behind) are landing on the adjacent runway, 18L and are arriving from the opposite (east) side of the airport from NASA 123. During the scenario, United 1212 intercepts the final approach course for 18R, rather than 18L. This places NASA 123 too close for a safe approach and landing.

SA Measurement

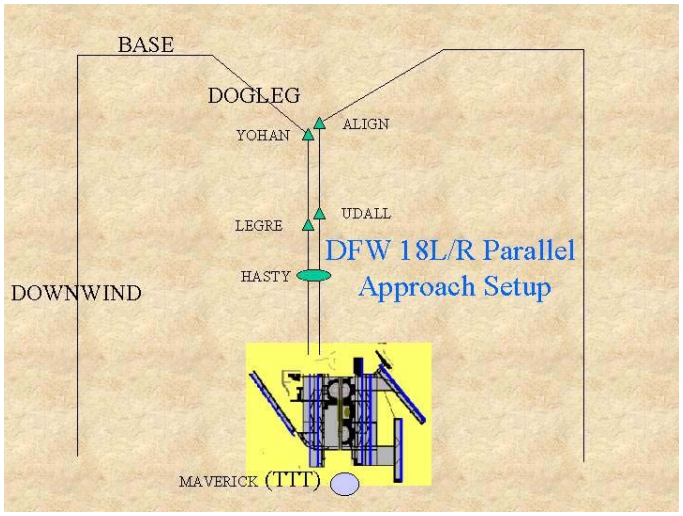
(1) Time to respond to the intruder aircraft should be calculated beginning with the time at which the intruder aircraft begins its deviation from the correct flight path. Pilot response may vary to include deviation off the flight path, changing speed, changing altitude, making an ATC call for a go around or a call to the intruder aircraft, or making a verbal comment.

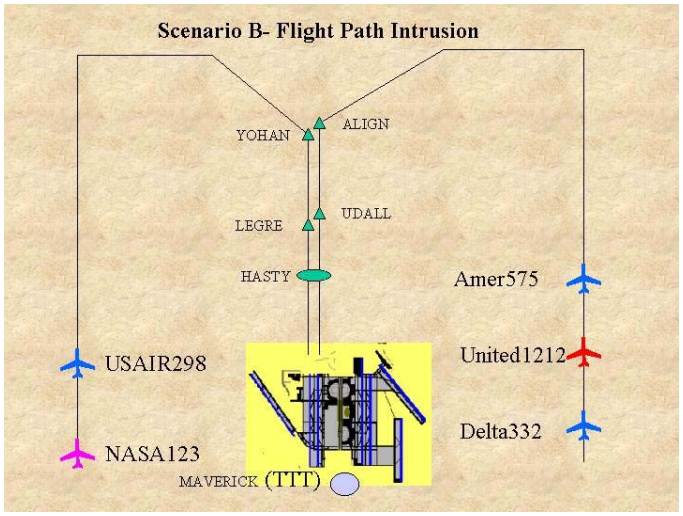
(2) SAGAT – The SA of the pilot should be measured via SAGAT queries at 3 different freeze points (at times 2.69, 8.56, and 12.90). Queries should include:

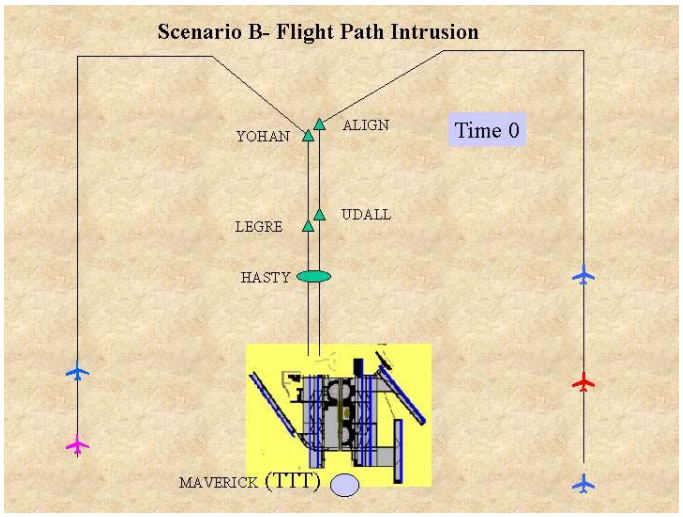
- Query 1 What is the current heading of your aircraft?
- Query 2 What is the current altitude (MSL) of your aircraft?
- Query 3 What is the indicated airspeed of your aircraft?
- Query 4 What is the current rate of climb/descent of your aircraft?
- Query 5 What is the attitude of your aircraft (pitch and bank)?
- Query 6 What are your current settings (flaps, slats, gear, speed brakes)?
- Query 7 How much fuel do you currently have?
- Query 8 What are the current winds (direction, magnitude, gusting to)?
- Query 14 Are you in conformance with your current clearance for this phase of flight?
- Query 15 Is there any conflicting traffic on your current (projected) flight path?
- Query 16 Conflicting traffic is currently located at (bearing and miles)?
- Query 17 Traffic Conflict Type
- Query 18 Is a change in path or altitude needed to avoid obstacles or terrain?
- Query 24 Are your systems correctly set-up for this phase of flight?
- Query 27 Are you on the proper glide path?
- Query 28 Where on the runway do you think you will touch down?
- Query 29 Where on the runway do you think you will stop the aircraft? (last stop only)
- Query 30 How far to the destination airport along your planned route of flight?
- Query 31 What is your current rate of closure on the aircraft in front of you?
- Query 32 How far to your next waypoint?

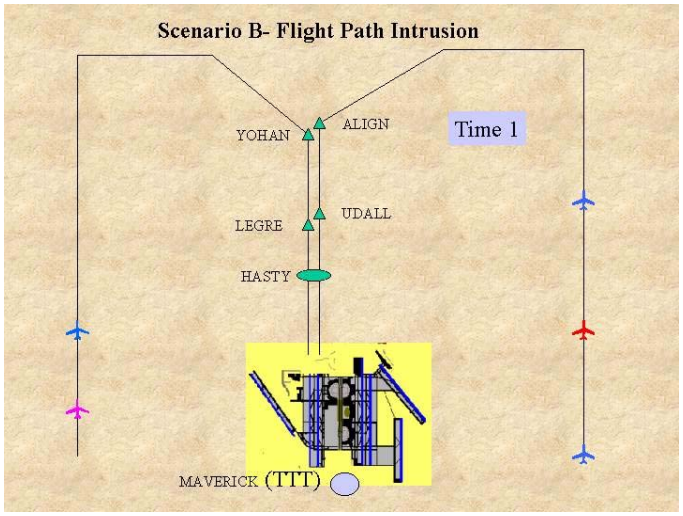
Scenarios for Assessing the Utility of Synthetic Visual Systems (SVS) in Commercial and Business (CaB) Aircraft

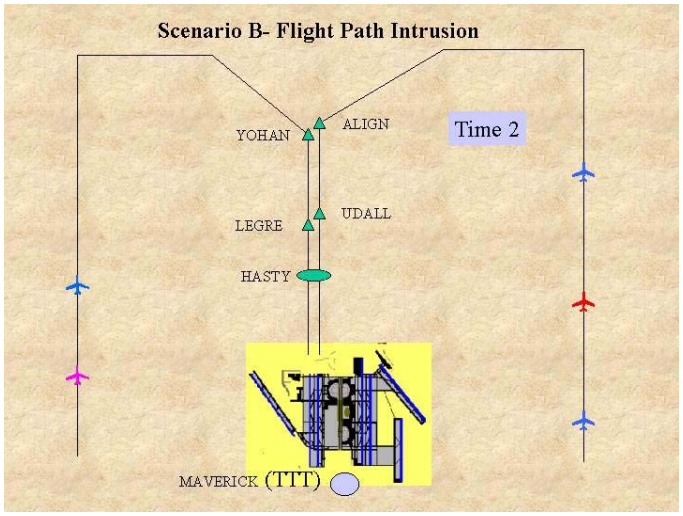
Scenario B - Flight Path Intrusion

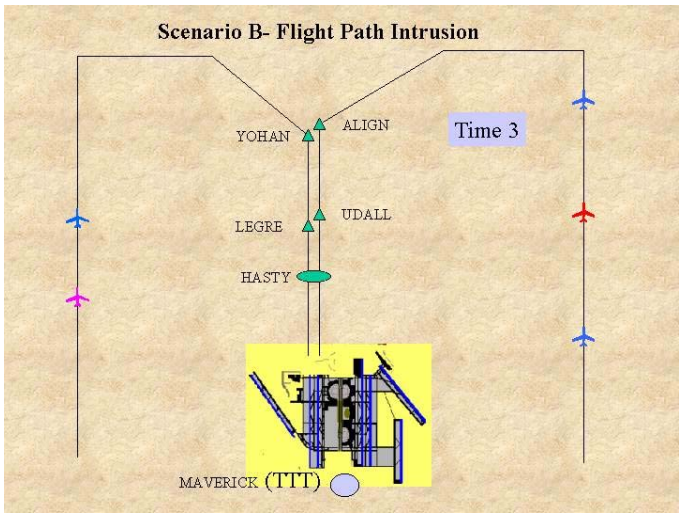


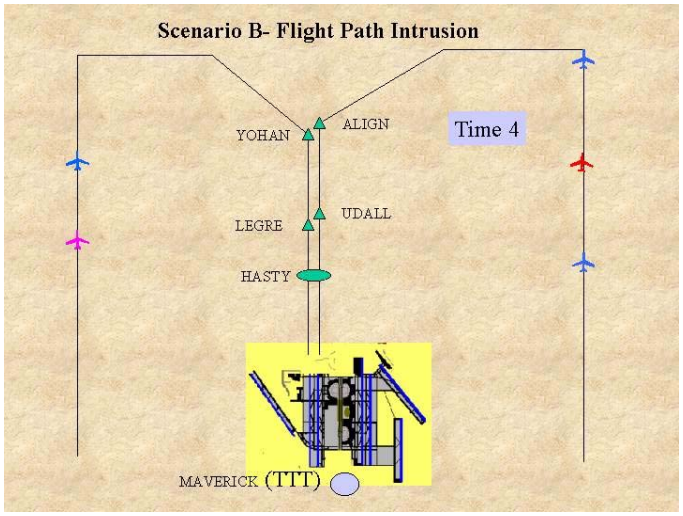


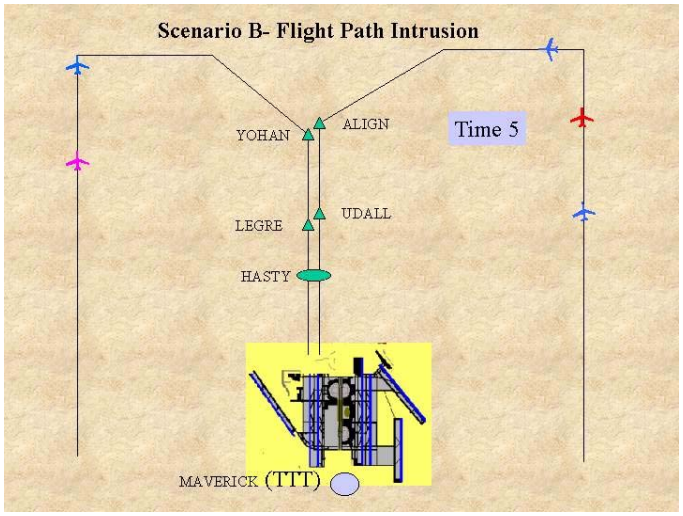

Scenario B- Flight Path Intrusion
YOHAN
ALIGN
Time 0
LEGRE
UDALL
HASTY
MAVERICK (TTT)

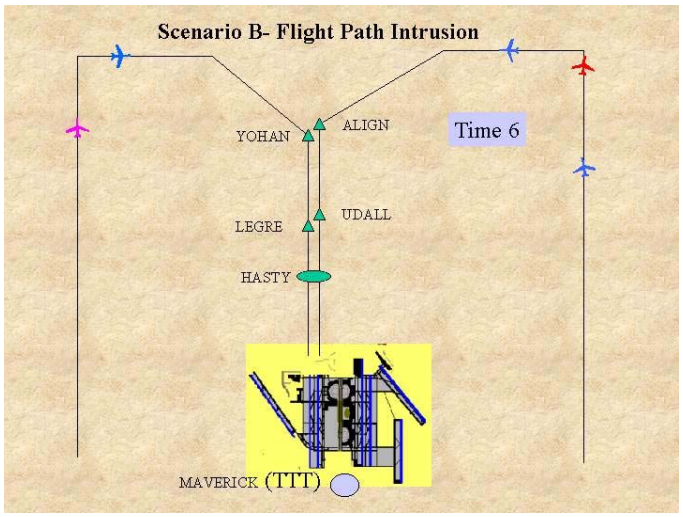

Scenario B- Flight Path Intrusion
YOHAN
ALIGN
Time 1
LEGRE
UDALL
HASTY
MAVERICK (TTT)

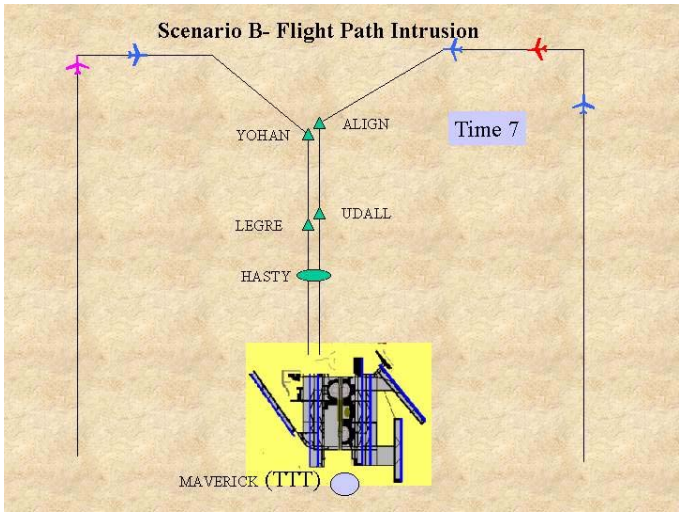

Scenario B- Flight Path Intrusion
YOHAN
ALIGN
Time 2
LEGRE
UDALL
HASTY
MAVERICK (TTT)

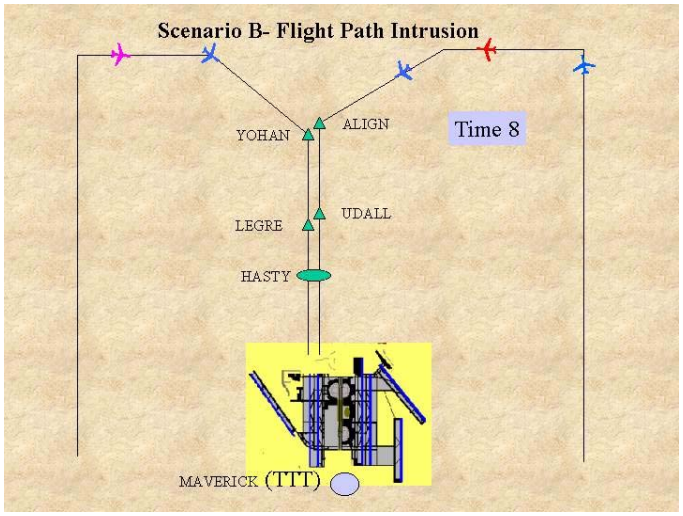

Scenario B- Flight Path Intrusion
YOHAN
ALIGN
Time 3
LEGRE
UDALL
HASTY
MAVERICK (TTT)

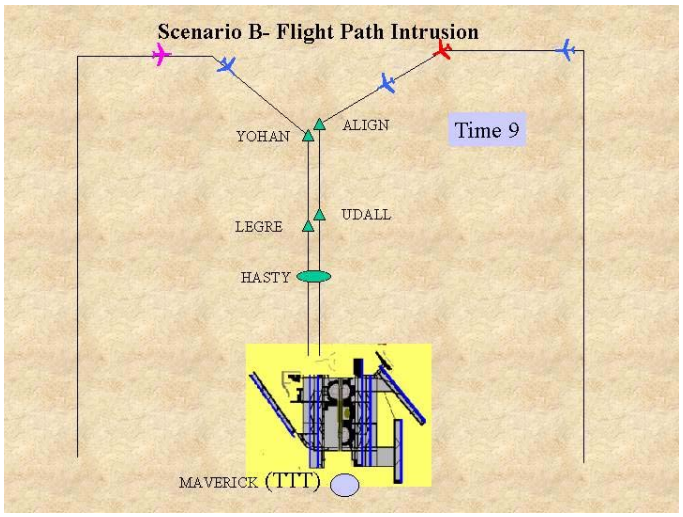

Scenario B- Flight Path Intrusion
YOHAN
ALIGN
Time 4
LEGRE
UDALL
HASTY
MAVERICK (TTT)

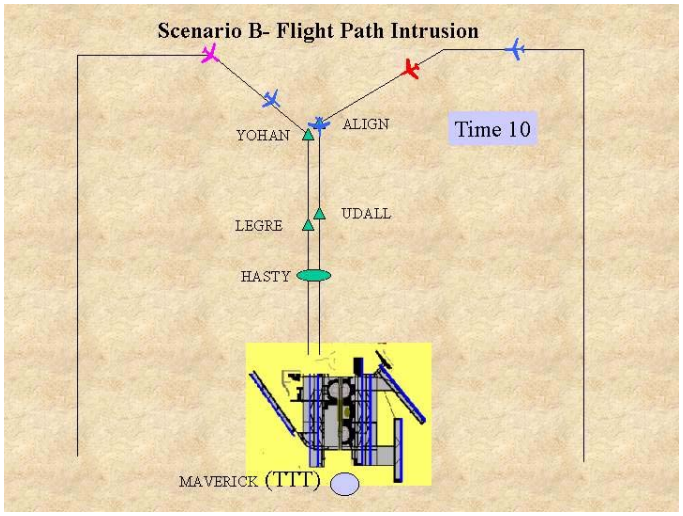

Scenario B- Flight Path Intrusion
YOHAN
ALIGN
Time 5
LEGRE
UDALL
HASTY
MAVERICK (TTT)

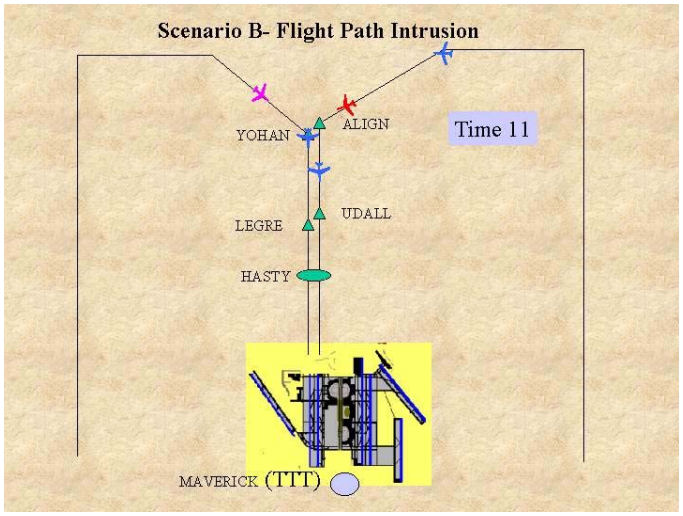

Scenario B- Flight Path Intrusion
YOHAN
ALIGN
Time 6
LEGRE
UDALL
HASTY
MAVERICK (TTT)

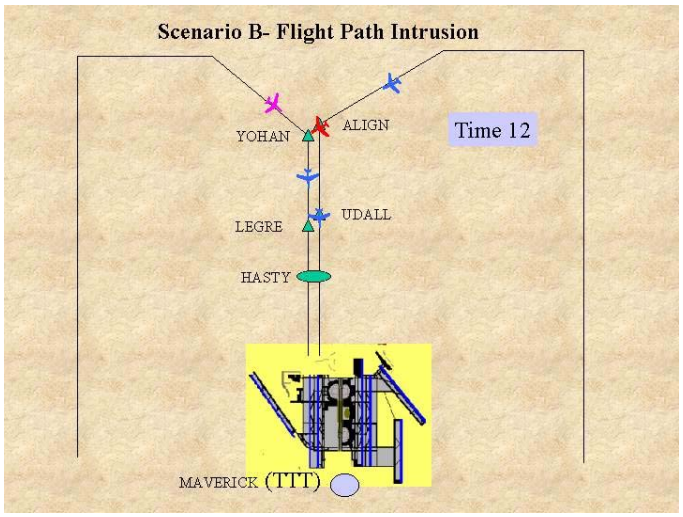

Scenario B- Flight Path Intrusion
YOHAN
ALIGN
Time 7
LEGRE
UDALL
HASTY
MAVERICK (TTT)

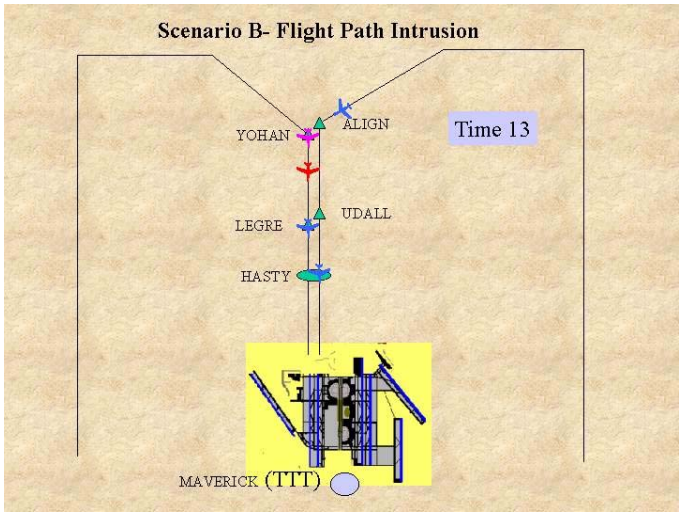

Scenario B- Flight Path Intrusion
YOHAN
ALIGN
Time 8
LEGRE
UDALL
HASTY
MAVERICK (TTT)

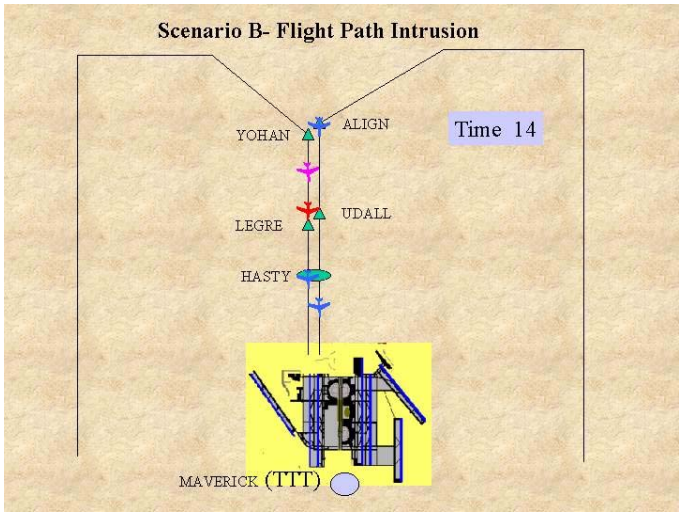

Scenario B- Flight Path Intrusion
YOHAN
ALIGN
Time 9
LEGRE
UDALL
HASTY
MAVERICK (TTT)

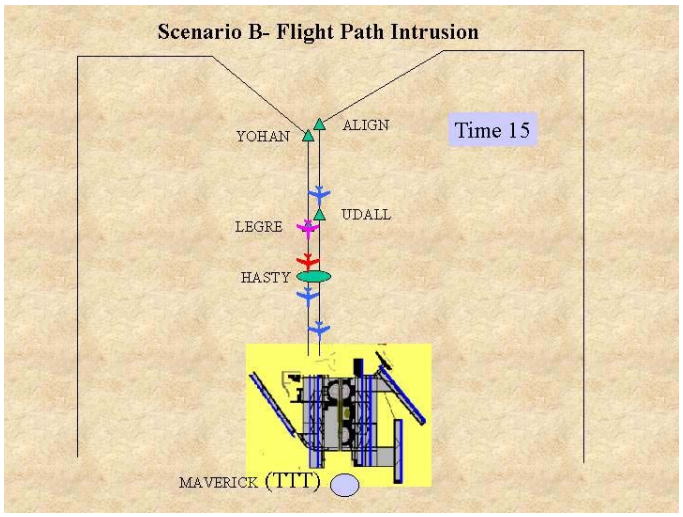

Scenario B- Flight Path Intrusion
YOHAN
ALIGN
Time 10
LEGRE
UDALL
HASTY
MAVERICK (TTT)

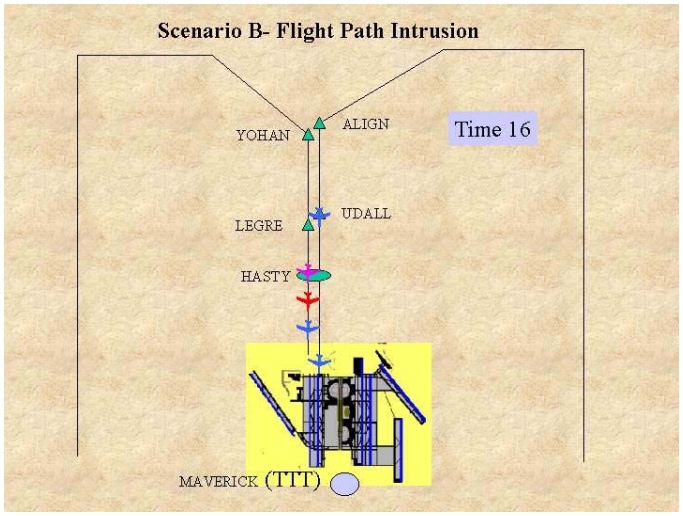

Scenario B- Flight Path Intrusion
YOHAN
ALIGN
Time 11
LEGRE
UDALL
HASTY
MAVERICK (TTT)

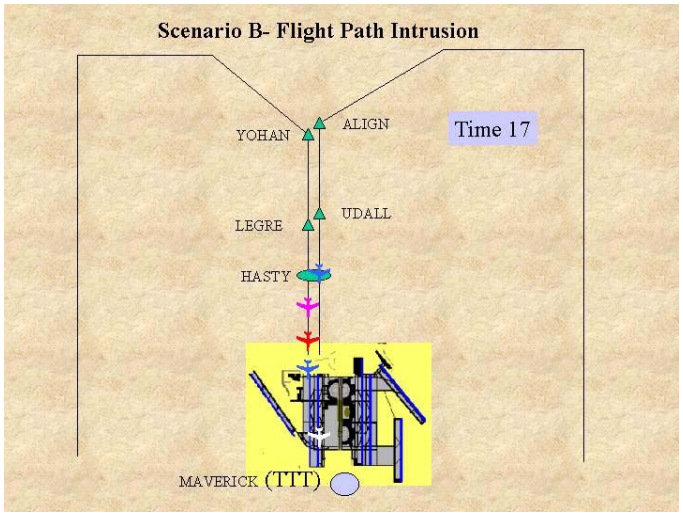

Scenario B- Flight Path Intrusion
YOHAN
ALIGN
Time 12
LEGRE
UDALL
HASTY
MAVERICK (TTT)

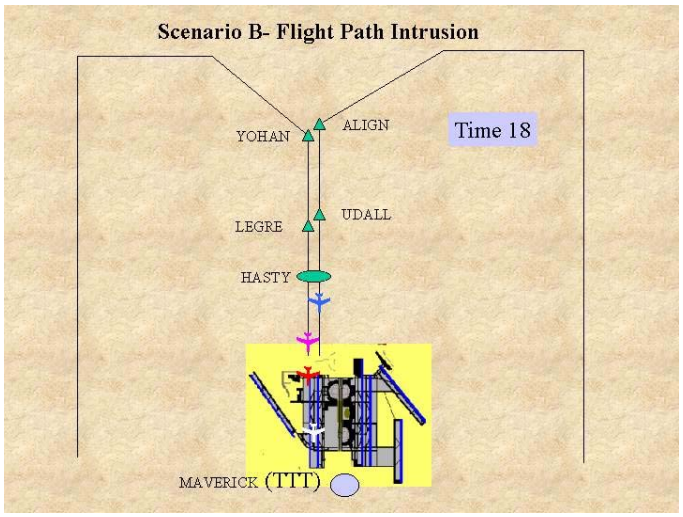

Scenario B- Flight Path Intrusion
YOHAN
ALIGN
Time 13
LEGRE
UDALL
HASTY
MAVERICK (TTT)

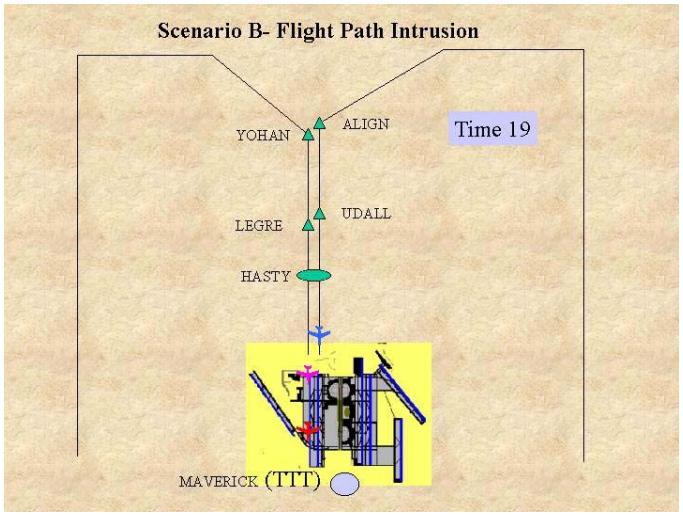

Scenario B- Flight Path Intrusion
YOHAN
ALIGN
Time 14
LEGRE
UDALL
HASTY
MAVERICK (TTT)

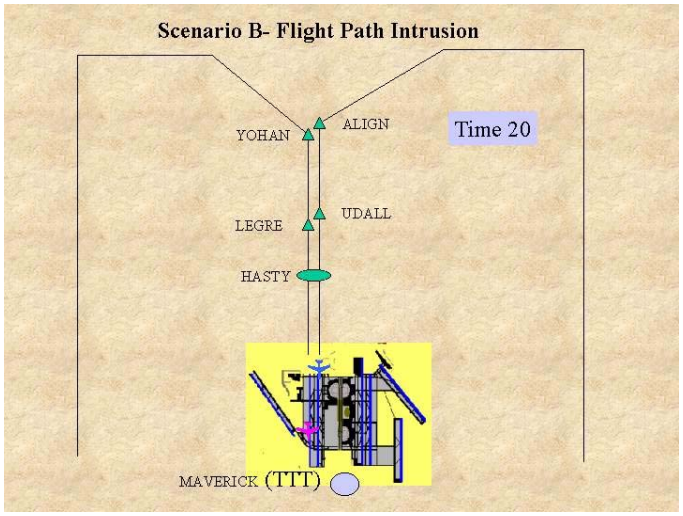

Scenario B- Flight Path Intrusion
YOHAN
ALIGN
Time 15
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Scenario B- Flight Path Intrusion
YOHAN
ALIGN
Time 16
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Scenario B- Flight Path Intrusion
YOHAN
ALIGN
Time 17
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Scenario B- Flight Path Intrusion
YOHAN
ALIGN
Time 18
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Scenario B- Flight Path Intrusion
YOHAN
ALIGN
Time 19
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Scenario B- Flight Path Intrusion
YOHAN
ALIGN
Time 20
LEGRE
UDALL
HASTY
MAVERICK (TTT)

Scenario B – Aircraft Data Files

NASA123

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
1	downwind		360	250	U	U	175	0
2	downwind	8000	360	250	U	U	175	0
3	downwind		360	250	U	U	175	0
4	downwind	7000	360	250	U	U	175	0
5	downwind		360	250	U	U	175	0
6	downwind	6000	360	250	U	U	175	0
7	downwind		360	230	U	U	175	0
8	turn to base	5000	360	210	U	U	175	0
9	base	5000	090	210	U	U	175	0
10	base	5000	090	210	U	U	175	0
11	turn to DL	5000	090	210	U	U	175	0
12	DL	3000	140	210	U	U	175	0
13	DL	3000	140	210	U	U	175	0
14	YOHAN	3000	175	210	U	U	175	0
15		3000	175	195	5	U	175	0
16	LEGRE	3000	175	180	15	U	175	0
17	HASTY	2400	175	180	15	U	175	0
18							175	0
19							175	0
20	touchdown	603	175	120	30	D	175	0
21	end of rwy	603	175	0	30	D	175	0

Time	Radio Traffic
0	
1	NASA123 - decend to 5000 ft
2	
3	
4	
5	
6	
7	NASA123 - turn rt hdg 090, maintain 210 kts
8	
9	
10	NASA123 - turn rt hdg 140, decend to 3000 ft
11	NASA123 - traffic 11 oclock, 3 miles
12	NASA123 - maintain visual seperation from that traffic
13	NASA123 - turn rt hdg 175, maintain 180 kts to the marker,
14	NASA123 cleared for the ILS app rwy 18R, tower now on 124.15
15	
16	NASA123, cleared to land
17	
18	
19	
0	NASA123, hold short runway 18L, contact twr 134.9

USAir298

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	downwind	8000	360	250	U	U	175	0
1	downwind		360	250	U	U	175	0
2	downwind	8000	360	250	U	U	175	0
3	downwind		360	250	U	U	175	0
4	downwind	6000	360	250	U	U	175	0
5	downwind		360	230	U	U	175	0
6	turn to base	5000	360	210	U	U	175	0
7	base	5000	090	210	U	U	175	0
8	base	5000	090	210	U	U	175	0
9	turn to DL	5000	090	210	U	U	175	0
10	DL	3000	140	210	U	U	175	0
11	DL	3000	140	210	U	U	175	0
12	YOHAN	3000	175	210	U	U	175	0
13		3000	175	195	5	U	175	0
14	LEGRE	3000	175	180	15	U	175	0
15	HASTY	2400	175	180	15	U	175	0
16							175	0
17							175	0
18	touchdown	603	175	120	30	D	175	0
19	end of rwy	603	175	0	30	D	175	0

Time	Radio Traffic
0	USAir298 - decend to 5000 ft
1	
2	
3	
4	
5	USAir298 - turn rt hdg 090, maintain 210 kts
6	
7	
8	USAir298 - turn rt hdg 140, decend to 3000 ft
9	USAir298 - traffic 11 oclock, 3 miles
10	USAir298 - maintain visual seperation from that traffic
11	USAir298 - turn rt hdg 175, maintain 180 kts to the marker.
12	USAir298, cleared for the ILS app rwy 18r, tower now on 124.15
13	
14	USAir298, cleared to land
15	
16	
17	
18	USAir298, hold short runway 18L, contact twr 134.9

American575

	location	alftitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	downwind		360	250	U	U	175	0
1	downwind	7000	360	250	U	U	175	0
2	downwind		360	250	U	U	175	0
3	downwind	6000	360	250	U	U	175	0
4	downwind		360	230	U	U	175	0
5	turn to base	5000	360	210	U	U	175	0
6	base	5000	270	210	U	U	175	0
7	base	5000	270	210	U	U	175	0
8	turn to DL	5000	270	210	U	U	175	0
9	DL	3000	220	210	U	U	175	0
10	DL	3000	220	210	U	U	175	0
11	ALIGN	3000	175	210	U	U	175	0
12		3000	175	195	5	U	175	0
13	UDALL	3000	175	180	15	U	175	0
14	HASTY	2300	175	180	15	U	175	0
15							175	0
16							175	0
17	touchdown	603	175	120	30	D	175	0
20	end of rwy	603	175	0	30	D	175	0

Time	Radio Traffic
0	
1	
2	
3	
4	American575 - turn lft hdg 270, maintain 210 kts
5	
6	
7	American575 - turn lft hdg 220, decend to 3000 ft
8	
9	
10	American575 - turn lft hdg 175, maintain 180 kts to the marker.
11	American575, cleared for the ILS app rwy 18L, tower now on 124.15
12	
13	American575, cleared to land
14	
15	
16	
17	American575, contact gnd

United1212

	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	downwind		360	250	U	U	175	0
1	downwind	8000	360	250	U	U	175	0
2	downwind		360	250	U	U	175	0
3	downwind	7000	360	250	U	U	175	0
4	downwind		360	250	U	U	175	0
5	downwind	6000	360	250	U	U	175	0
6	downwind		360	230	U	U	175	0
7	turn to base	5000	360	210	U	U	175	0
8	base	5000	270	210	U	U	175	0
9	base	5000	270	210	U	U	175	0
10	turn to DL	5000	270	210	U	U	175	0
11	DL	3000	220	210	U	U	175	0
12	DL	3000	220	210	U	U	175	0
13	YOHAN	3000	175	210	U	U	175	0
14		3000	175	195	5	U	175	0
15	LEGRE	3000	175	180	15	U	175	0
16	HASTY	2300	175	180	15	U	175	0
17							175	0
18							175	0
19	touchdown	603	175	120	30	D	175	0
20	end of rwy	603	175	0	30	D	175	0

Time	Radio Traffic
0	United1212 - decend to 5000 ft
1	
2	
3	
4	
5	
6	United1212 - turn lft hdg 270, maintain 210 kts
7	
8	
9	United1212 - turn lft hdg 220, decend to 3000 ft
10	United1212 - traffic 1 oclock, 3 miles
11	United1212 - maintain visual seperation from that traffic
12	United1212 - turn lft hdg 175, maintain 180 kts to the marker.
13	United1212, cleared for the ILS app rwy 18L, tower now on 124.15
14	
15	United1212, cleared to land
16	
17	
18	
20	United1212, contact gnd

Delta332

	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
2	downwind		360	250	U	U	175	0
3	downwind	8000	360	250	U	U	175	0
4	downwind		360	250	U	U	175	0
5	downwind	7000	360	250	U	U	175	0
6	downwind		360	250	U	U	175	0
7	downwind	6000	360	250	U	U	175	0
8	downwind		360	230	U	U	175	0
9	turn to base	5000	360	210	U	U	175	0
10	base	5000	270	210	U	U	175	0
11	base	5000	270	210	U	U	175	0
12	turn to DL	5000	270	210	U	U	175	0
13	DL	3000	220	210	U	U	175	0
14	DL	3000	220	210	U	U	175	0
15	ALIGN	3000	175	210	U	U	175	0
16		3000	175	195	5	U	175	0
17	UDALL	3000	175	180	15	U	175	0
18	HASTY	2300	175	180	15	U	175	0
19							175	0
20							175	0
21	touchdown	603	175	120	30	D	175	0
20	end of rwy	603	175	0	30	D	175	0

Time	Radio Traffic
2	Delta332 - decend to 5000 ft
3	
4	
5	
6	
7	
8	Delta332 - turn lft hdg 270, maintain 210 kts
9	
10	
11	Delta332 - turn lft hdg 210, decend to 3000 ft
12	Delta332 - traffic 1 oclock, 3 miles
13	Delta332 - maintain visual seperation from that traffic
14	Delta332 - turn lft hdg 175, maintain 180 kts to the marker
15	Delta332, cleared for the ILS app rwy 18L, tower now on 124.15
16	
17	Delta332, cleared to land
18	
19	
20	
21	Delta332, contact gnd

ATC Master Communication Log- Scenario B

Air Traffic Controller Radio Communications

Scripted Radio Calls from Other Aircraft

NASA 123 Radio Suggested Radio Calls

Time 0

USAir 298, level at 11000 ft.
Hello USAir 298 - descend to 5000 ft
USAir 298, descending to 5000 ft
DFW approach, United1212
United1212, Roger
United1212 - descend to 5000 ft
5000 ft, United1212

Time 1

Approach, NASA 123, 11000 ft.
NASA123 - descend to 5000 ft
(Read back clearance)

Time 2

Delta332 checking in
Roger Delta332
Delta332 - descend to 5000 ft
(Read back clearance)

Time 3

Time 4

Amer575 - turn left hdg 270, maintain 210 kts
(Read back clearance)

Time 5

USAir 298 - turn right hdg 090, maintain 210 kts
(Read back clearance)

Time 6

United1212 - turn left hdg 270, maintain 210 kts
(Read back clearance)

Time 7

Amer575 - turn left hdg 210, descend to 3000 ft
(Read back clearance)
USAir 298 - turn right hdg 140, descend to 3000 ft
(Read back clearance)
NASA123 - turn right hdg 090, maintain 210 kts
(Read back clearance)

Time 8

Delta332 - turn left hdg 270, maintain 210 kts
(Read back clearance)

Time 9

United1212 - turn left hdg 210, descend to 3000 ft
(Read back clearance)
USAir 298 - traffic 11 o'clock, 3 miles
Roger, USAir 298 Looking…

Time 10

Amer575 - turn left hdg 175, maintain 180 kts to the marker, cleared for the ILS app rwy 18L, tower now on 124.15
(Read back clearance)
United1212 - traffic 1 o'clock, 3 miles
United1212 looking
USAir 298, traffic in sight
Roger USAir 298 - maintain visual separation from that traffic
NASA123 - turn right hdg 140, descend to 3000 ft
(Read back clearance)

Time 11

Delta332 - turn left hdg 210, descend to 3000 ft
(Read back clearance)
USAir 298 - turn right hdg 175, maintain 180 kts to the marker, cleared for the ILS app rwy 18r, tower now on 124.15
(Read back clearance)
NASA123 - traffic 11 o'clock, 3 miles
Subject to call traffic in sight
USAir 298, cleared to land
United1212, traffic in sight
Roger United1212 - maintain visual separation from that traffic
(Read back clearance)

Time 12

United1212 - turn left hdg 175, maintain 180 kts to the marker, cleared for the ILS app rwy 18L, tower now on 124.15
(Read back clearance)
United has now intercepted the wrong ILS course (!8R) and is three miles ahead of NASA 123.
NASA123 - maintain visual separation from that traffic
(Read back clearance)
Delta332 - traffic 1 o'clock, 3 miles
Delta332 looking

Time 13

Amer575, cleared to land
(Read back clearance)
NASA123 - turn right hdg 175, maintain 180 kts to the marker, cleared for the ILS app rwy 18r, tower now on 124.15
(Read back clearance)
Delta332, traffic in sight
Roger Delta332 - maintain visual separation from that traffic
(Read back clearance)

Time 14

Delta332 - turn left hdg 175, maintain 180 kts to the marker, cleared for the ILS app rwy 18L, tower now on 124.15
(Read back clearance)
USAir 298, cleared to land
(Read back clearance)

Time 15

United1212, cleared to land
(Read back clearance)

Time 16

NASA123, cleared to land
(Read back clearance)

Time 17

Delta332, cleared to land
(Read back clearance)
Amer575, contact ground
(Read back clearance)

Time 18

USAir 298, hold short runway 18L
(Read back clearance)

Time 19

United1212, contact ground
(Read back clearance)

Time 20

NASA123, hold short runway 18L
(Read back clearance)

Time 21

Delta332, contact ground
(Read back clearance)

Line Oriented Evaluation Scenario C

Land and Hold Short Operations (LASHO)

SVS Aspects Tested: The following CaB SVS CONOPS applications are tested in this scenario.

Approach Phase

- Self Separation:
  - A-10 Land and Hold Short (LASHO)

Time: 22 minutes

This scenario tests the ability of the subject to develop and maintain general situation awareness of multiple aircraft during a normal approach and landing. It also tests the subject's ability to perform a LASHO operation using the SVS. The scenario is constructed such that the sequence of each aircraft is one minute spacing (approximately 3 miles) from the aircraft ahead during the final approach phase and two minute spacing on the aircraft ahead that is landing on the same runway. In addition to the test subjects aircraft (NASA 123) there are three other aircraft in the pattern, two which will be ahead of NASA 123 and one behind. One aircraft (Northwest 234) is two minutes directly ahead of NASA 123 and both aircraft are being vectored for approach to Rwy 18R at DFW. Two aircraft (one ahead, the one behind) are landing on the adjacent runway, 18L and are arriving from the opposite (east) side of the airport from NASA 123. All aircraft are being instructed to hold short of taxiway B, which is standard practice for LASHO operations at DFW.

The scenario starts with NASA 123 on the west side of DFW, level at 11,000 feet and northbound on downwind for Rwy 18R. Radio traffic indicates that three other aircraft are in the pattern. The scenario continues as each aircraft is sequenced into a single final approach corridor to cross HASTY final approach fix at one minute intervals. This scenario would be not be realistic in the current ATC environment.

SA Measurement

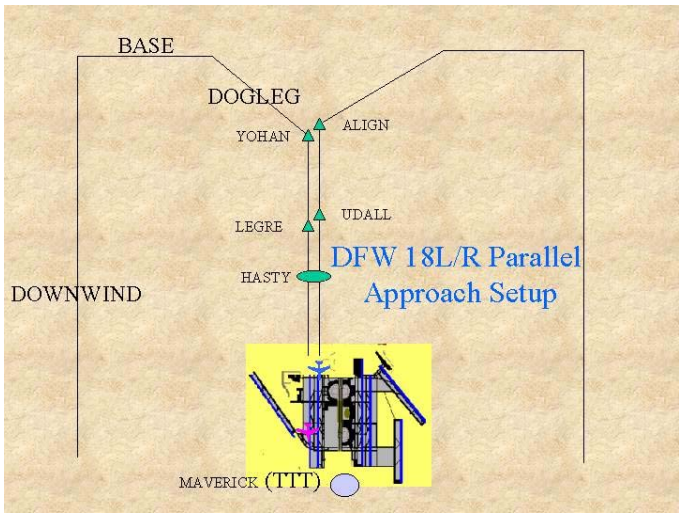
(1) Flight path adherence – The ability of the pilot to adhere to the desired flight path should be measured. This would include ability to maintain the required spacing from other aircraft, adherence to ATC commands, and deviations from glide slope. In addition, distance from taxiway B at the stop point on the runway should be measured.

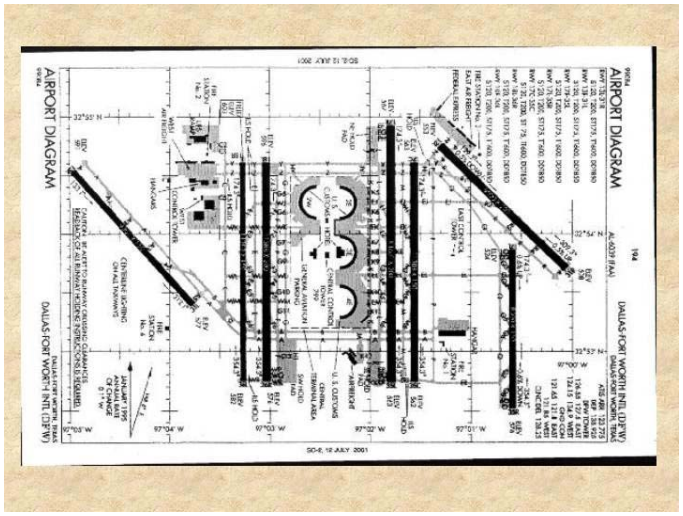
(2) SAGAT – The SA of the pilot should be measured via SAGAT queries at 3 different freeze points (at times 8.40, 16.56, and 19.44). Queries should include:

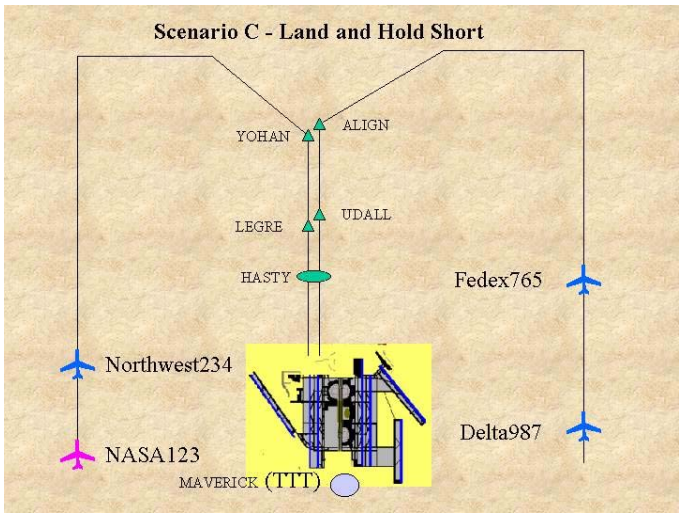
- Query 1 What is the current heading of your aircraft?
- Query 2 What is the current altitude (MSL) of your aircraft?
- Query 3 What is the indicated airspeed of your aircraft?
- Query 4 What is the current rate of climb/descent of your aircraft?
- Query 5 What is the attitude of your aircraft (pitch and bank)?
- Query 6 What are your current settings (flaps, slats, gear, speed brakes)?
- Query 7 How much fuel do you currently have?
- Query 8 What are the current winds (direction, magnitude, gusting to)?
- Query 14 Are you in conformance with your current clearance for this phase of flight?
- Query 15 Is there any conflicting traffic on your current (projected) flight path?
- Query 16 Conflicting traffic is currently located at (bearing and miles)?
- Query 17 Traffic Conflict Type
- Query 18 Is a change in path or altitude needed to avoid obstacles or terrain?
- Query 24 Are your systems correctly set-up for this phase of flight?
- Query 27 Are you on the proper glide path?
- Query 28 Where on the runway do you think you will touch down?
- Query 29 Where on the runway do you think you will stop the aircraft? (last stop only)
- Query 30 How far to the destination airport along your planned route of flight?
- Query 31 What is your current rate of closure on the aircraft in front of you?
- Query 32 How far to your next waypoint?

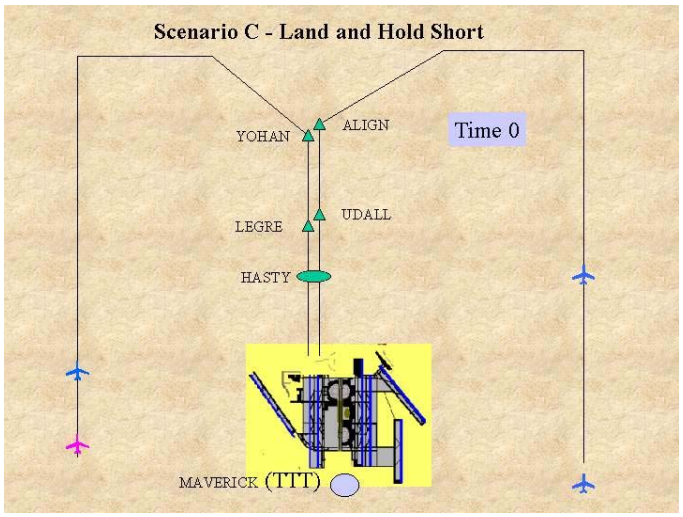
Scenarios for Assessing the Utility of Synthetic Visual Systems (SVS) in Commercial and Business (CaB) Aircraft

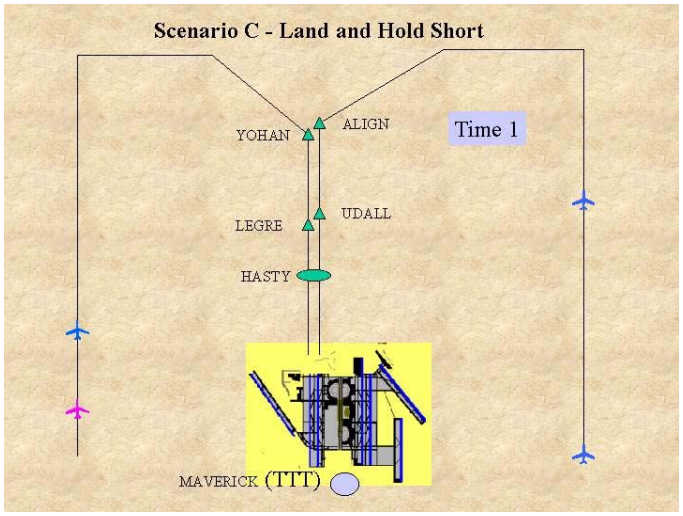
Scenario C - Land and Hold Short

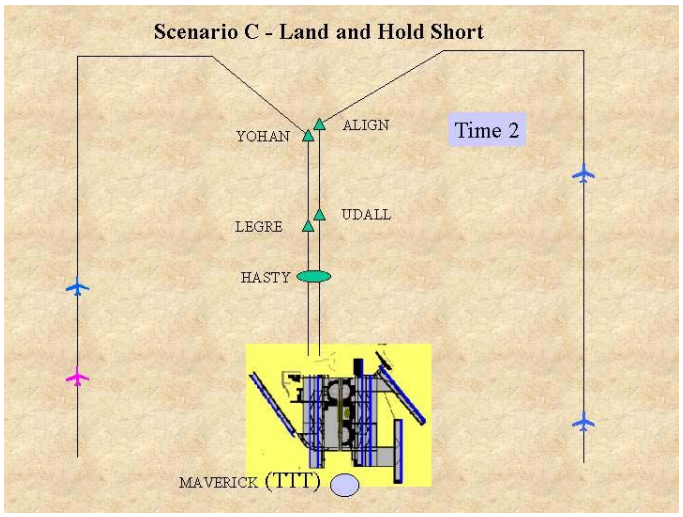


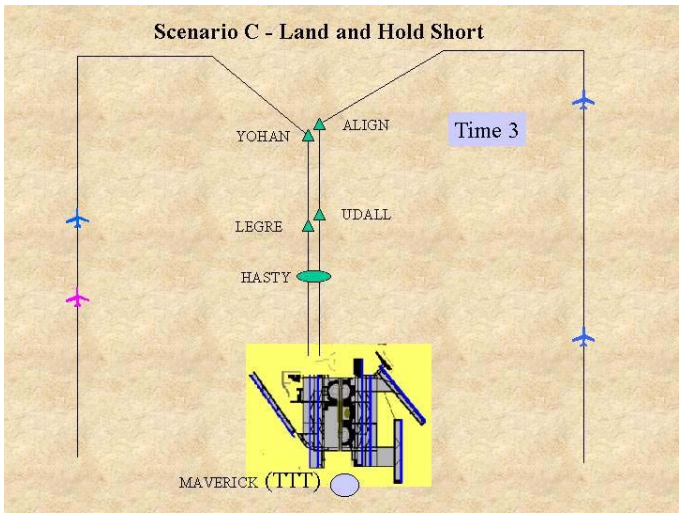


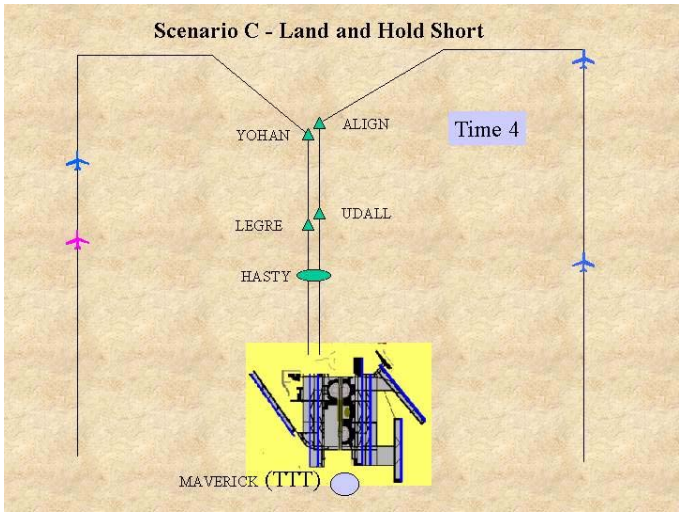

Scenario C - Land and Hold Short
YOHAN
ALIGN
LEGRE
UDALL
HASTY
Fedex765
Northwest234
NASA123
Delta987
MAVERICK (TTT)

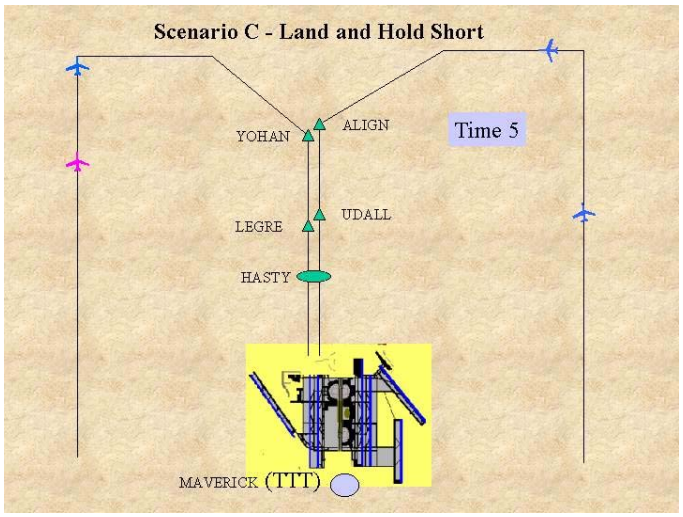

Scenario C - Land and Hold Short
YOHAN
ALIGN
Time 0
LEGRE
UDALL
HASTY
MAVERICK (TTT)

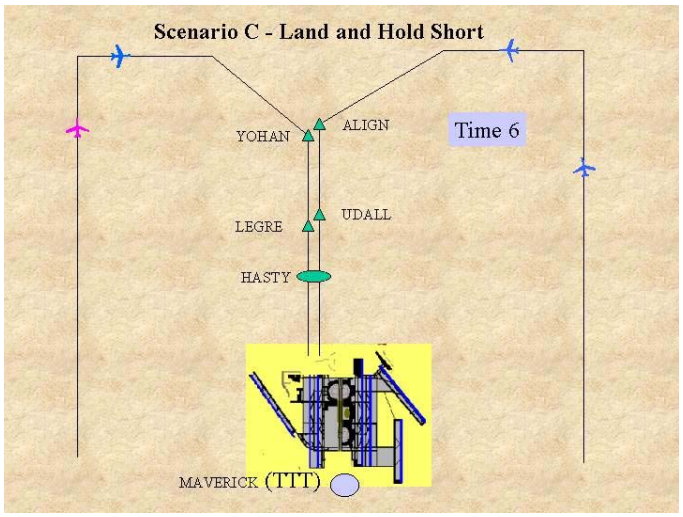

Scenario C - Land and Hold Short
YOHAN
ALIGN
Time 1
LEGRE
UDALL
HASTY
MAVERICK (TTT)

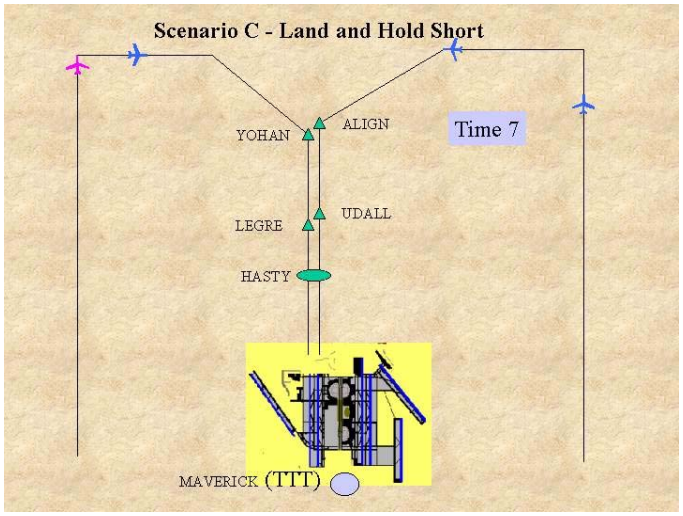

Scenario C - Land and Hold Short
YOHAN
ALIGN
Time 2
LEGRE
UDALL
HASTY
MAVERICK (TTT)

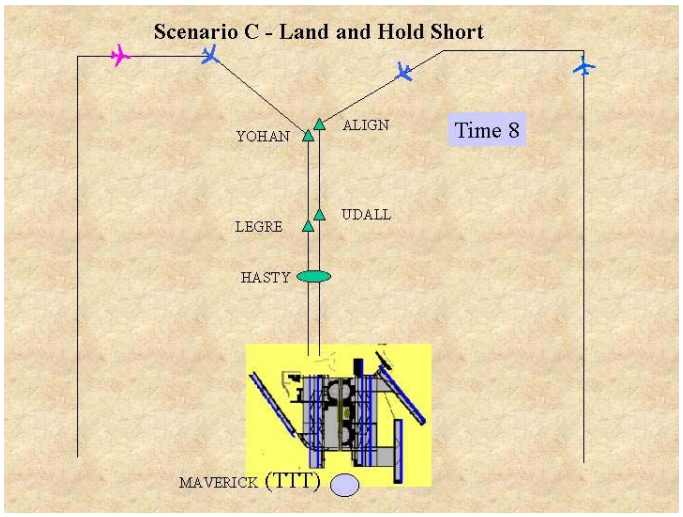

Scenario C - Land and Hold Short
YOHAN
ALIGN
Time 3
LEGRE
UDALL
HASTY
MAVERICK (TTT)

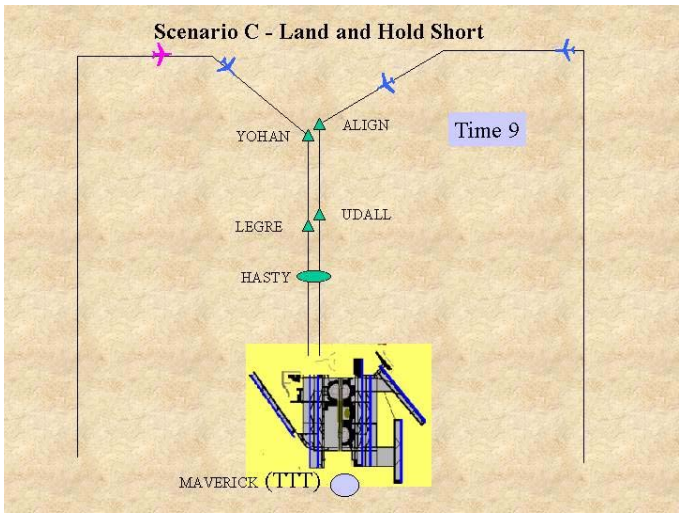

Scenario C - Land and Hold Short
YOHAN
ALIGN
Time 4
LEGRE
UDALL
HASTY
MAVERICK (TTT)

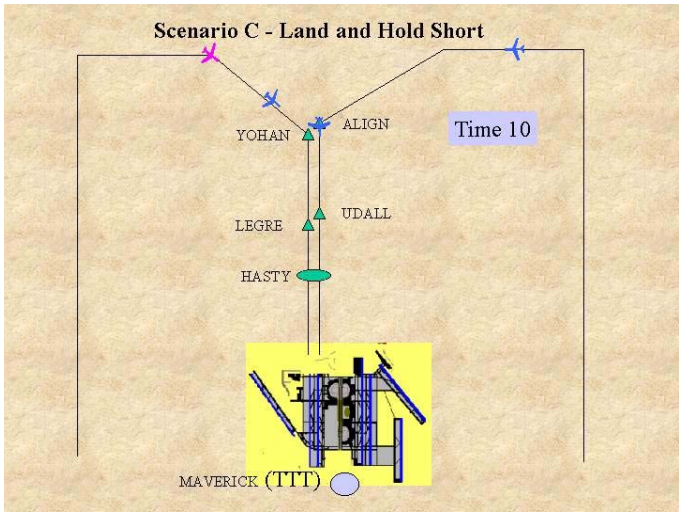

Scenario C - Land and Hold Short
YOHAN
ALIGN
Time 5
LEGRE
UDALL
HASTY
MAVERICK (TTT)

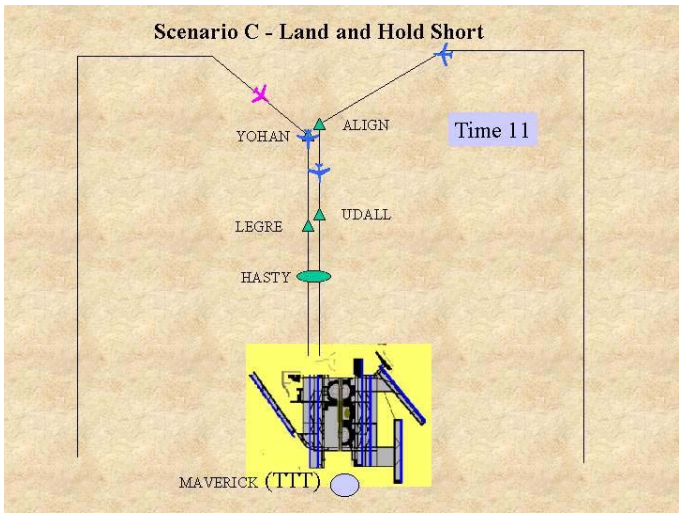

Scenario C - Land and Hold Short
YOHAN
ALIGN
Time 6
LEGRE
UDALL
HASTY
MAVERICK (TTT)

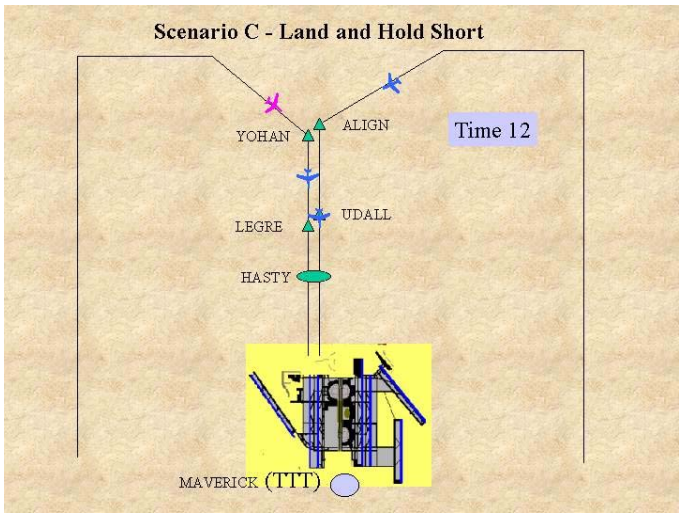

Scenario C - Land and Hold Short
YOHAN
ALIGN
Time 7
LEGRE
UDALL
HASTY
MAVERICK (TTT)

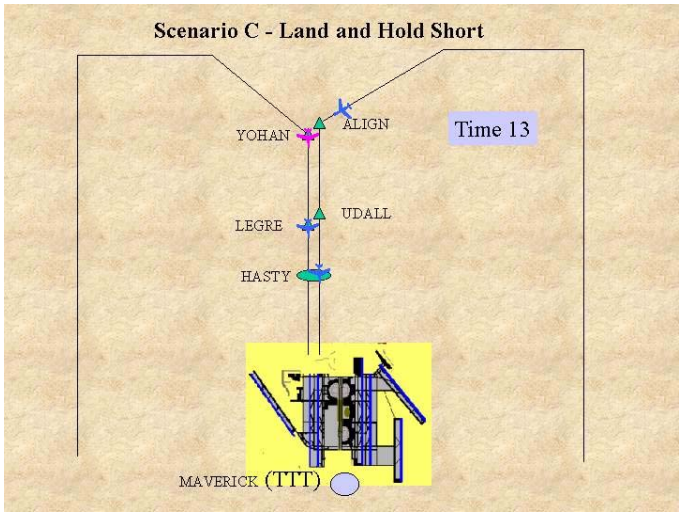

Scenario C - Land and Hold Short
YOHAN
ALIGN
Time 8
LEGRE
UDALL
HASTY
MAVERICK (TTT)

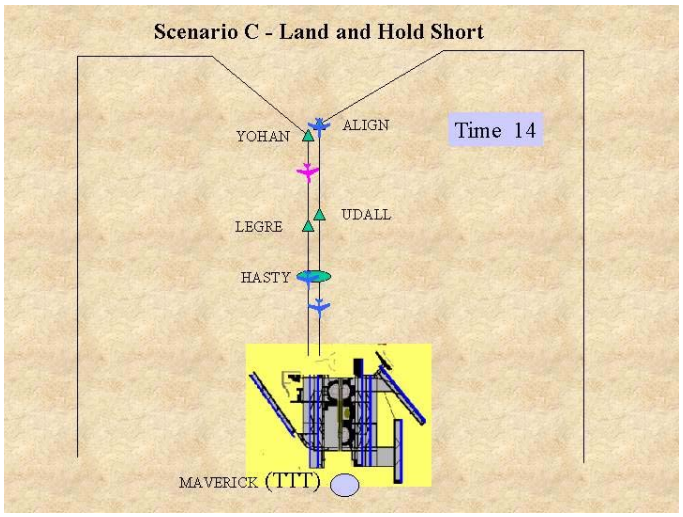

Scenario C - Land and Hold Short
YOHAN
ALIGN
Time 9
LEGRE
UDALL
HASTY
MAVERICK (TTT)

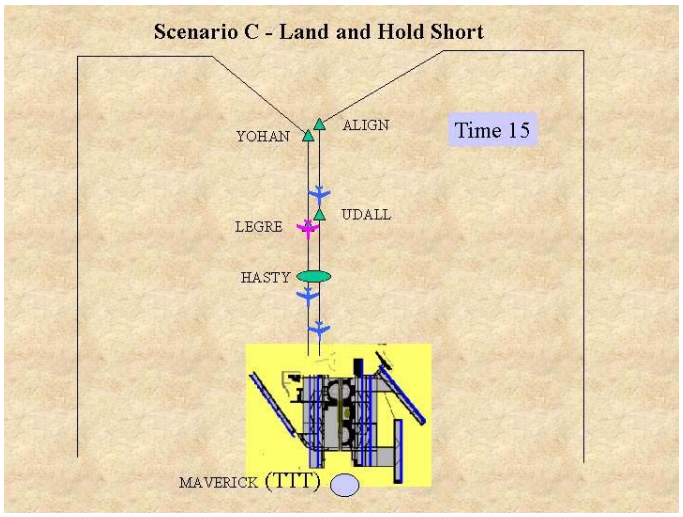

Scenario C - Land and Hold Short
YOHAN
ALIGN
Time 10
LEGRE
UDALL
HASTY
MAVERICK (TTT)

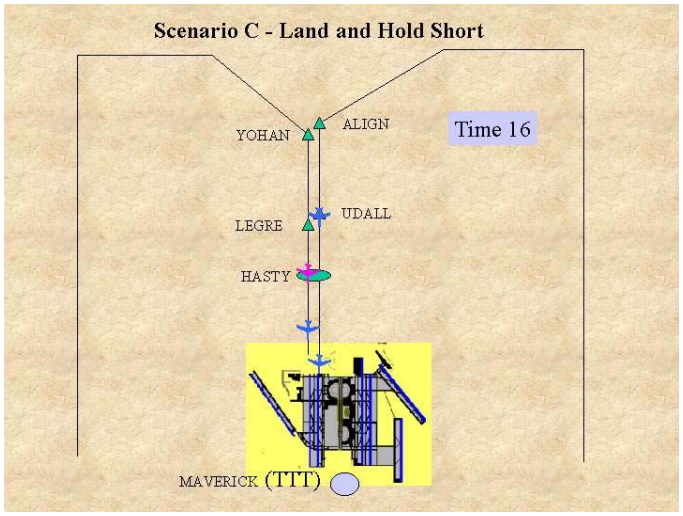

Scenario C - Land and Hold Short
YOHAN
ALIGN
Time 11
LEGRE
UDALL
HASTY
MAVERICK (TTT)

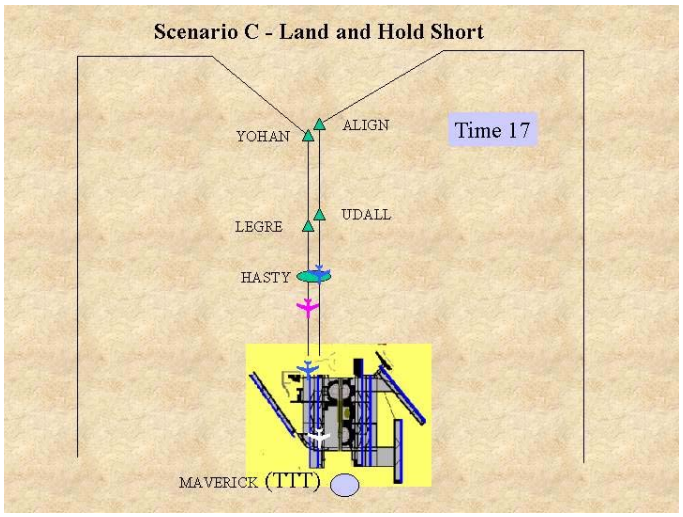

Scenario C - Land and Hold Short
YOHAN
ALIGN
Time 12
LEGRE
UDALL
HASTY
MAVERICK (TTT)

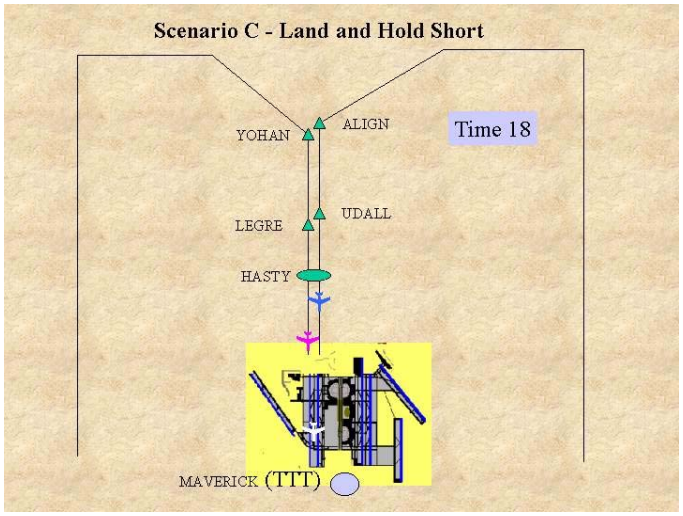

Scenario C - Land and Hold Short
YOHAN
ALIGN
Time 13
LEGRE
UDALL
HASTY
MAVERICK (TTT)

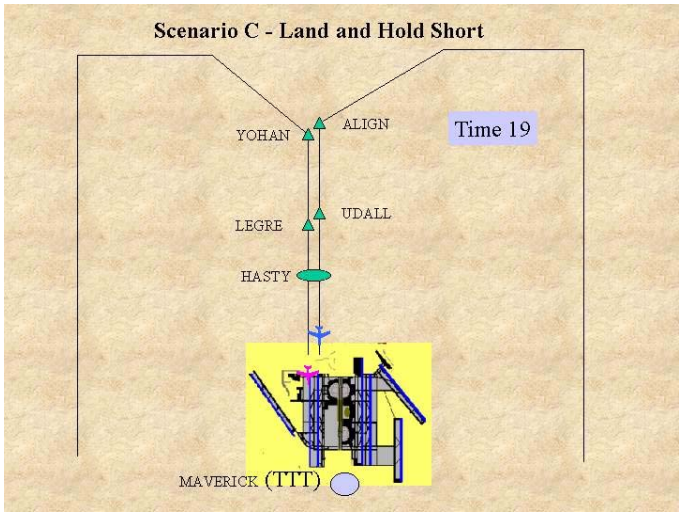

Scenario C - Land and Hold Short
YOHAN
ALIGN
Time 14
LEGRE
UDALL
HASTY
MAVERICK (TTT)

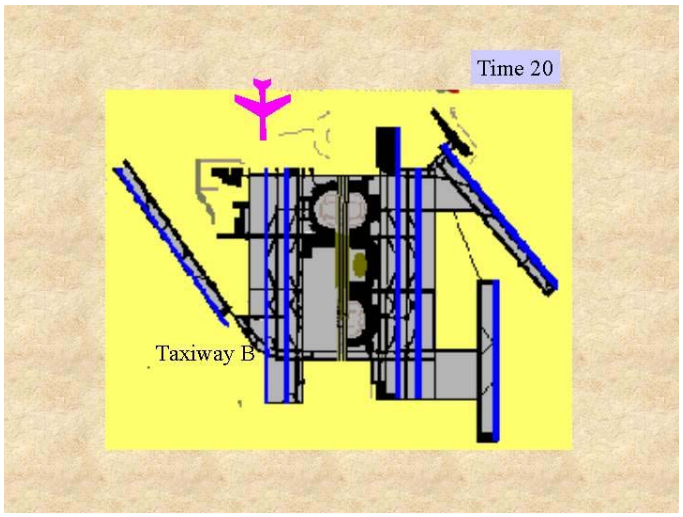

Scenario C - Land and Hold Short
YOHAN
ALIGN
Time 15
LEGRE
UDALL
HASTY
MAVERICK (TTT)

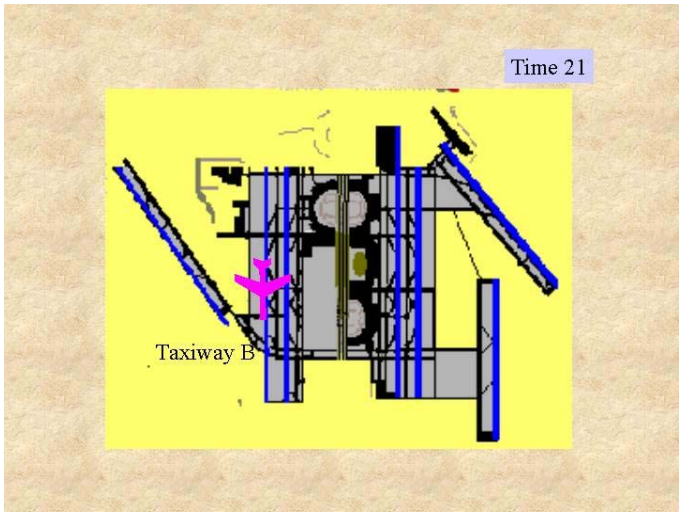

Scenario C - Land and Hold Short
YOHAN
ALIGN
Time 16
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Scenario C - Land and Hold Short
YOHAN
ALIGN
Time 17
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Scenario C - Land and Hold Short
YOHAN
ALIGN
Time 18
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Scenario C - Land and Hold Short
YOHAN
ALIGN
Time 19
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Time 20
Taxiway B


Time 21
Taxiway B

Scenario C – Aircraft Data Files

NASA123

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
1	downwind		360	250	U	U	175	0
2	downwind	8000	360	250	U	U	175	0
3	downwind		360	250	U	U	175	0
4	downwind	7000	360	250	U	U	175	0
5	downwind		360	250	U	U	175	0
6	downwind	6000	360	250	U	U	175	0
7	downwind		360	230	U	U	175	0
8	turn to base	5000	360	210	U	U	175	0
9	base	5000	090	210	U	U	175	0
10	base	5000	090	210	U	U	175	0
11	turn to DL	5000	090	210	U	U	175	0
12	DL	3000	140	210	U	U	175	0
13	DL	3000	140	210	U	U	175	0
14	YOHAN	3000	175	210	U	U	175	0
15		3000	175	195	5	U	175	0
16	LEGRE	3000	175	180	15	U	175	0
17	HASTY	2400	175	180	15	U	175	0
18							175	0
19							175	0
20	touchdown	603	175	120	30	D	175	0
20	end of rwy	603	175	0	30	D	175	0

Time	Radio Traffic
0	
1	NASA123 - decend to 5000 ft
2	
3	
4	
5	
6	
7	NASA123 - turn rt hdg 090, maintain 210 kts
8	
9	
10	NASA123 - turn rt hdg 140, decend to 3000 ft
11	
12	
13	NASA123 - turn rt hdg 175, maintain 180 kts to the marker,
14	NASA123 cleared for the ILS app rwy 18R, tower now on 124.15
15	
16	NASA123, cleared to land, hold short taxiway B
17	
18	
19	
20	NASA123, hold short runway 18L, contact twr 134.9

Northwest234

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	downwind	8000	360	250	U	U	175	0
1	downwind		360	250	U	U	175	0
2	downwind	8000	360	250	U	U	175	0
3	downwind		360	250	U	U	175	0
4	downwind	6000	360	250	U	U	175	0
5	downwind		360	230	U	U	175	0
6	turn to base	5000	360	210	U	U	175	0
7	base	5000	090	210	U	U	175	0
8	base	5000	090	210	U	U	175	0
9	turn to DL	5000	090	210	U	U	175	0
10	DL	3000	140	210	U	U	175	0
11	DL	3000	140	210	U	U	175	0
12	YOHAN	3000	175	210	U	U	175	0
13		3000	175	195	5	U	175	0
14	LEGRE	3000	175	180	15	U	175	0
15	HASTY	2400	175	180	15	U	175	0
16							175	0
17							175	0
18	touchdown	603	175	120	30	D	175	0
19	end of rwy	603	175	0	30	D	175	0

Time	Radio Traffic
0	
1	
2	
3	
4	
5	Northwest234 - turn rt hdg 090, maintain 210 kts
6	
7	
8	Northwest234 - turn rt hdg 140, decend to 3000 ft
9	Northwest234 - traffic 11 oclock, 3 miles
10	Northwest234 - maintain visual seperation from that traffic
11	Northwest234 - turn rt hdg 175, maintain 180 kts to the marker.
12	Northwest234, cleared for the ILS app rwy 18r, tower now on 124.15
13	
14	Northwest234, cleared to land, hold short taxiway B
15	
16	
17	
19	Northwest234, hold short runway 18L, contact twr 134.9

Fedex765

	location	alftitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	downwind		360	250	U	U	175	0
1	downwind	7000	360	250	U	U	175	0
2	downwind		360	250	U	U	175	0
3	downwind	6000	360	250	U	U	175	0
4	downwind		360	230	U	U	175	0
5	turn to base	5000	360	210	U	U	175	0
6	base	5000	270	210	U	U	175	0
7	base	5000	270	210	U	U	175	0
8	turn to DL	5000	270	210	U	U	175	0
9	DL	3000	220	210	U	U	175	0
10	DL	3000	220	210	U	U	175	0
11	ALIGN	3000	175	210	U	U	175	0
12		3000	175	195	5	U	175	0
13	UDALL	3000	175	180	15	U	175	0
14	HASTY	2300	175	180	15	U	175	0
15							175	0
16							175	0
17	touchdown	603	175	120	30	D	175	0
21	end of rwy	603	175	0	30	D	175	0

Time	Radio Traffic
0	
1	
2	
3	
4	Fedex765 - turn lft hdg 270, maintain 210 kts
5	
6	
7	Fedex765 - turn lft hdg 220, decend to 3000 ft
8	
9	
10	Fedex765 - turn lft hdg 175, maintain 180 kts to the marker.
11	Fedex765, cleared for the ILS app rwy 18L, tower now on 124.15
12	
13	Fedex765, cleared to land, hold short taxiway B
14	
15	
16	
17	Fedex765, contact gnd

Delta987

	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
2	downwind		360	250	U	U	175	0
3	downwind	8000	360	250	U	U	175	0
4	downwind		360	250	U	U	175	0
5	downwind	7000	360	250	U	U	175	0
6	downwind		360	250	U	U	175	0
7	downwind	6000	360	250	U	U	175	0
8	downwind		360	230	U	U	175	0
9	turn to base	5000	360	210	U	U	175	0
10	base	5000	270	210	U	U	175	0
11	base	5000	270	210	U	U	175	0
12	turn to DL	5000	270	210	U	U	175	0
13	DL	3000	220	210	U	U	175	0
14	DL	3000	220	210	U	U	175	0
15	ALIGN	3000	175	210	U	U	175	0
16		3000	175	195	5	U	175	0
17	UDALL	3000	175	180	15	U	175	0
18	HASTY	2300	175	180	15	U	175	0
19							175	0
20							175	0
21	touchdown	603	175	120	30	D	175	0
21	end of rwy	603	175	0	30	D	175	0

Time	Radio Traffic
2	Delta987 - decend to 5000 ft
3	
4	
5	
6	
7	
8	Delta987 - turn lft hdg 270, maintain 210 kts
9	
10	
11	Delta987 - turn lft hdg 210, decend to 3000 ft
12	Delta987 - traffic 1 oclock, 3 miles
13	Delta987 - maintain visual seperation from that traffic
14	Delta987 - turn lft hdg 175, maintain 180 kts to the marker
15	Delta987, cleared for the ILS app rwy 18L, tower now on 134.9
16	
17	Delta987, cleared to land - hold short taxiway B
18	
19	
20	
21	Delta987, contact gnd

ATC Master Communication Log- Scenario C

Air Traffic Controller Radio Communications

Scripted Radio Calls from Other Aircraft

NASA 123 Radio Suggested Radio Calls

Time 0

Time 1

Approach, NASA 123, 11000 ft.
NASA123 - descend to 5000 ft
(Read back clearance)

Time 2

Delta987 checking in
Roger Delta987
Delta987 - descend to 5000 ft
(Read back clearance)

Time 3

Time 4

Fedex 765 - turn left hdg 270, maintain 210 kts
(Read back clearance)

Time 5

Northwest 234 - turn right hdg 090, maintain 210 kts
(Read back clearance)

Time 6

Time 7

Fedex 765 - turn left hdg 210, descend to 3000 ft
(Read back clearance)
NASA123 - turn right hdg 090, maintain 210 kts
(Read back clearance)

Time 8

Northwest 234 - turn right hdg 140, descend to 3000 ft
(Read back clearance)
Delta987 - turn left hdg 270, maintain 210 kts
(Read back clearance)

Time 9

Northwest 234 - traffic 11 o'clock, 3 miles
Roger, Northwest 234 Looking…

Time 10

Fedex 765 - turn left hdg 175, maintain 180 kts to the marker, cleared for the ILS app rwy 18L, tower now on 124.15
(Read back clearance)
Northwest 234, traffic in sight
Roger Northwest 234 - maintain visual separation from that traffic
NASA123 - turn right hdg 140, descend to 3000 ft
(Read back clearance)

Time 11

Delta987 - turn left hdg 210, descend to 3000 ft
(Read back clearance)
Northwest 234 - turn right hdg 175, maintain 180 kts to the marker, cleared for the ILS app rwy 18r, tower now on 124.15
(Read back clearance)

Time 12

Delta987, traffic 1 o'clock, three miles
Delta987, looking…

Time 13

Delta 987, traffic in sight
Roger Delta987, maintain visual separation from that traffic
Fedex 765, cleared to land, hold short taxiway B
(Read back clearance)
NASA123 - turn right hdg 175, maintain 180 kts to the marker, cleared for the ILS app rwy 18r, tower now on 124.15
(Read back clearance)

Time 14

Delta987 - turn left hdg 175, maintain 180 kts to the marker, cleared for the ILS app rwy 18L, tower now on 124.15
(Read back clearance)
Northwest 234, cleared to land, Hold short taxiway B
(Read back clearance)

Time 15

Time 16

NASA123, cleared to land, hold short taxiway B
(Read back clearance)

Time 17

Delta987, cleared to land, hold short taxiway B
(Read back clearance)
Fedex 765, contact ground
(Read back clearance)

Time 18

Northwest 234, hold short runway 18L,
(Read back clearance)

Time 19

Time 20

NASA123, hold short runway 18L,
(Read back clearance)

Time 21

Delta987, contact ground
(Read back clearance)

Line Oriented Evaluation Scenario D

Station Keeping on Closely Spaced Parallel Approach
Runway Incursion During Landing
Go-Around

SVS Aspects Tested: The following CaB SVS CONOPS applications are tested in this scenario.

Approach Phase

- Self Separation:
  - A-7 De-Conflict Approaches
  - A-8 Identify Traffic Ahead
  - A-9 Self Separation
  - A-11 Runway Incursions
  - A-12 Closely Spaced Parallel Approaches
  - A-14 Station Keeping
  - A-16 Missed Approaches

Time: 22 minutes

This scenario tests the ability of the subject to develop and maintain general situation awareness of multiple aircraft during a normal approach and landing. Additionally, during the landing maneuver, an aircraft crosses downfield and the subject must execute a missed approach. The scenario is constructed such that the sequence of each aircraft is one minute spacing (approximately 3 miles) from the aircraft ahead during the final approach phase and two minute spacing on the aircraft ahead that is landing on the same runway. In addition to the test subjects aircraft (NASA 123) there are four other aircraft in the pattern, two which will be ahead of NASA 123 and two behind. One aircraft (United 98) is two minutes directly ahead of NASA 123 and both aircraft are being vectored for approach to Rwy 18L at DFW. Delta 543 is two minutes behind. Two aircraft (one ahead, the one behind) are landing on the adjacent runway, 18L and are arriving from the opposite (west) side of the airport from NASA 123.

The scenario starts with NASA 123 on the west side of DFW, level at 11,000 feet and northbound on downwind for Rwy 18L. Radio traffic indicates that four other aircraft are in the pattern. The scenario continues as each aircraft is sequenced into a single final approach corridor to cross HASTY final approach fix at one minute intervals. This scenario would not be realistic in the current ATC environment. One-minute intervals are chosen to allow for sufficient wake turbulence protection.

During the landing phase of NASA 123, American 1505 does not hold short of runway 18L and crosses the runway at taxiway WM. The scenario ends when the subject detects the intruder and starts a go around.

SA Measurement

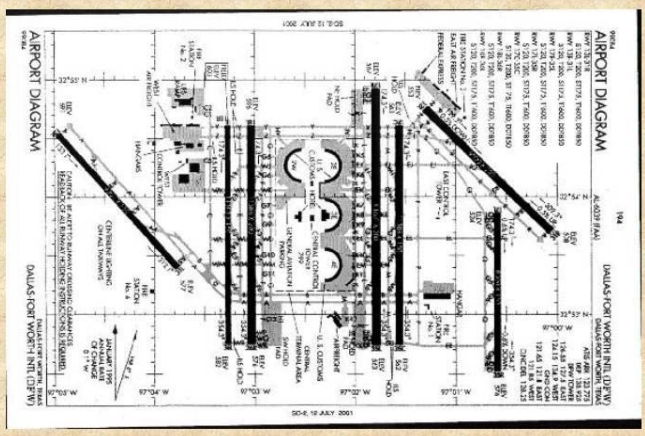
(1) Time to respond to the intruder aircraft should be calculated beginning with the time at which the intruder aircraft begins its deviation from the correct flight path. Pilot response may vary to include deviation off the flight path, changing speed, changing altitude, making an ATC call for a go around or a call to the intruder aircraft, or making a verbal comment.

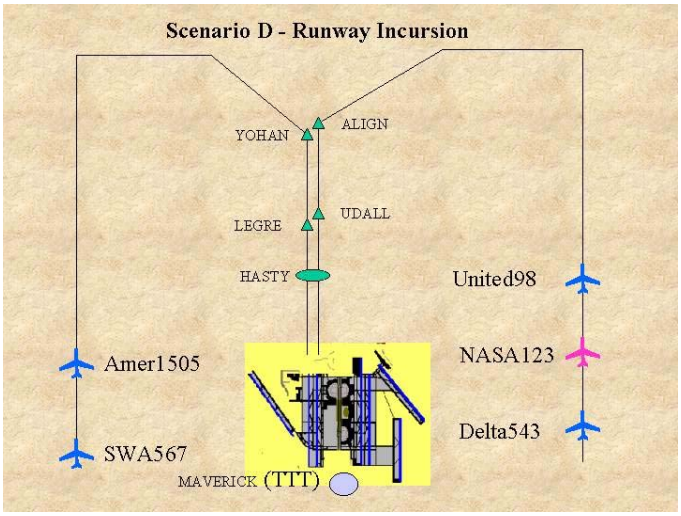
(2) SAGAT – The SA of the pilot should be measured via SAGAT queries at 3 different freeze points (at times 5.85, 14.57, and 19.66). Queries should include:

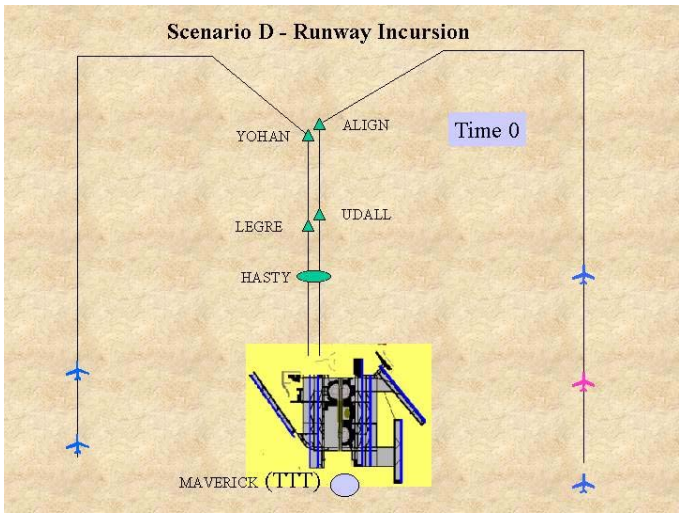
- Query 1 What is the current heading of your aircraft?
- Query 2 What is the current altitude (MSL) of your aircraft?
- Query 3 What is the indicated airspeed of your aircraft?
- Query 4 What is the current rate of climb/descent of your aircraft?
- Query 5 What is the attitude of your aircraft (pitch and bank)?
- Query 6 What are your current settings (flaps, slats, gear, speed brakes)?
- Query 7 How much fuel do you currently have?
- Query 8 What are the current winds (direction, magnitude, gusting to)?
- Query 14 Are you in conformance with your current clearance for this phase of flight?
- Query 15 Is there any conflicting traffic on your current (projected) flight path?
- Query 16 Conflicting traffic is currently located at (bearing and miles)?
- Query 17 Traffic Conflict Type
- Query 18 Is a change in path or altitude needed to avoid obstacles or terrain?
- Query 24 Are your systems correctly set-up for this phase of flight?
- Query 27 Are you on the proper glide path?
- Query 28 Where on the runway do you think you will touch down?
- Query 29 Where on the runway do you think you will stop the aircraft? (last stop only)
- Query 30 How far to the destination airport along your planned route of flight?
- Query 31 What is your current rate of closure on the aircraft in front of you?
- Query 32 How far to your next waypoint?

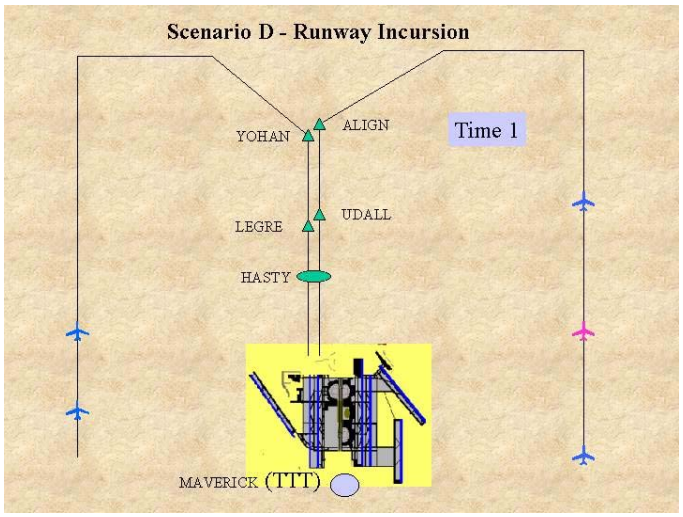
Scenarios for Assessing the Utility of Synthetic Visual Systems (SVS) in Commercial and Business (CaB) Aircraft

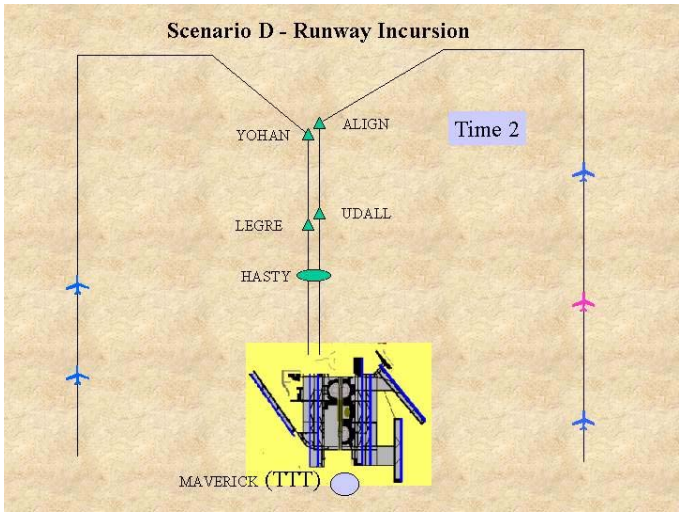
Scenario D - Runway Incursion

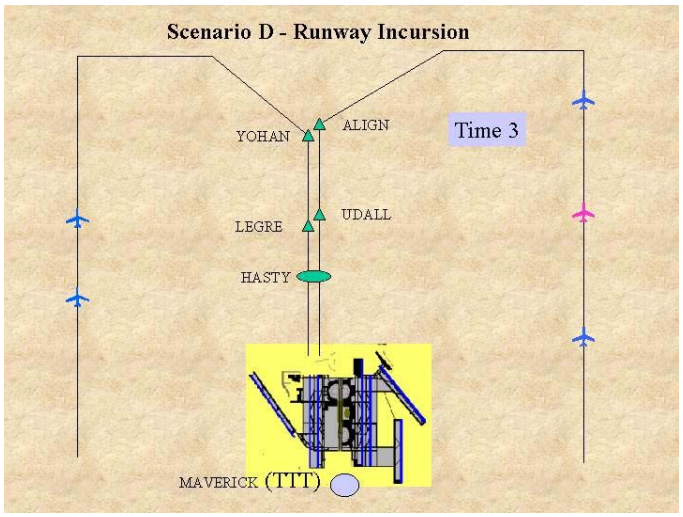


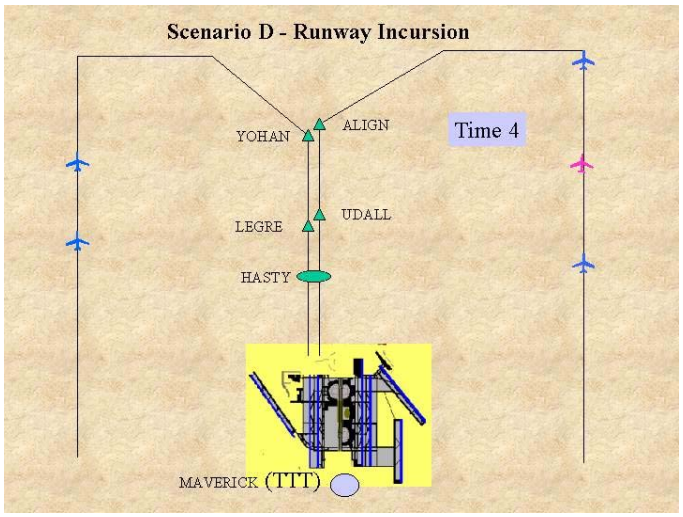


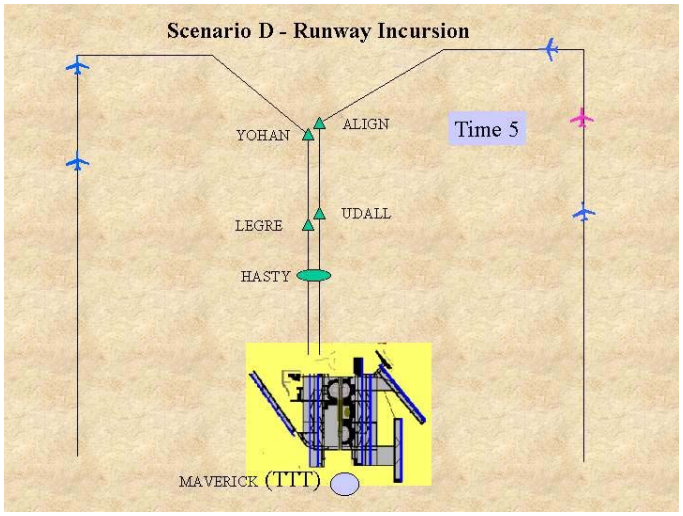

Scenario D - Runway Incursion
YOHAN
ALIGN
Time 0
LEGRE
UDALL
HASTY
MAVERICK (TTT)

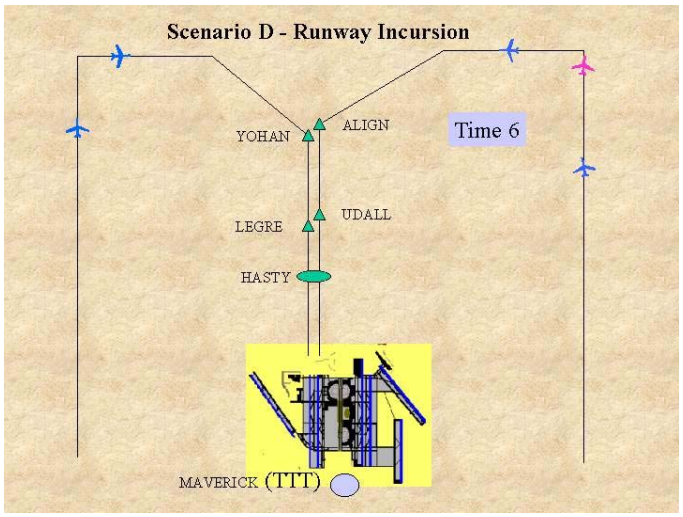

Scenario D - Runway Incursion
YOHAN
ALIGN
Time 1
LEGRE
UDALL
HASTY
MAVERICK (TTT)

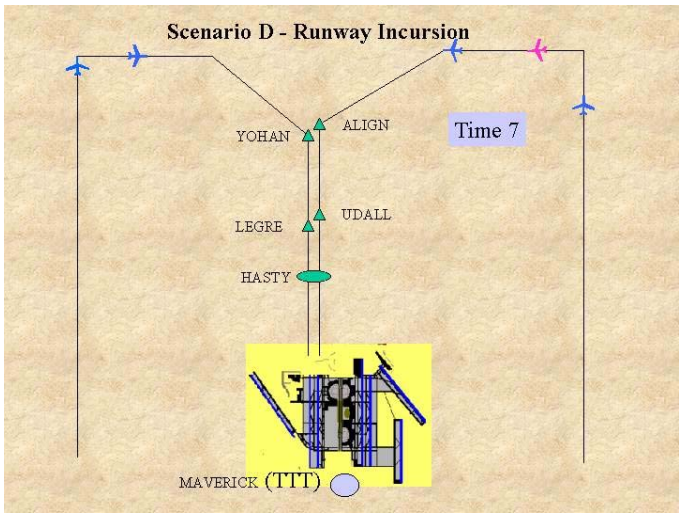

Scenario D - Runway Incursion
YOHAN
ALIGN
Time 2
LEGRE
UDALL
HASTY
MAVERICK (TTT)

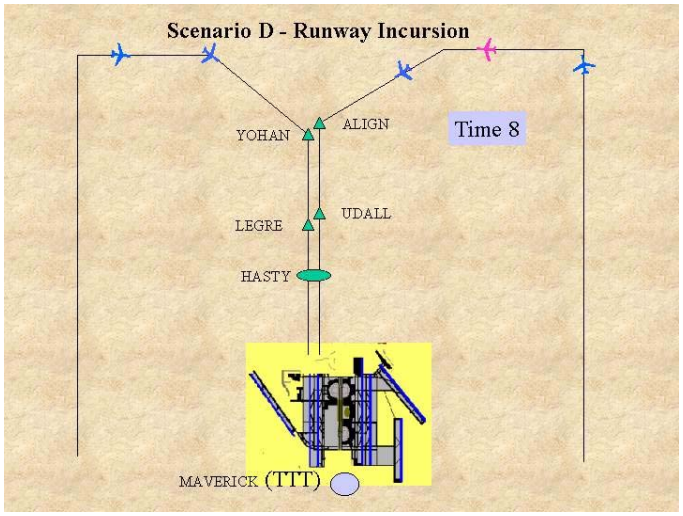

Scenario D - Runway Incursion
YOHAN
ALIGN
Time 3
LEGRE
UDALL
HASTY
MAVERICK (TTT)

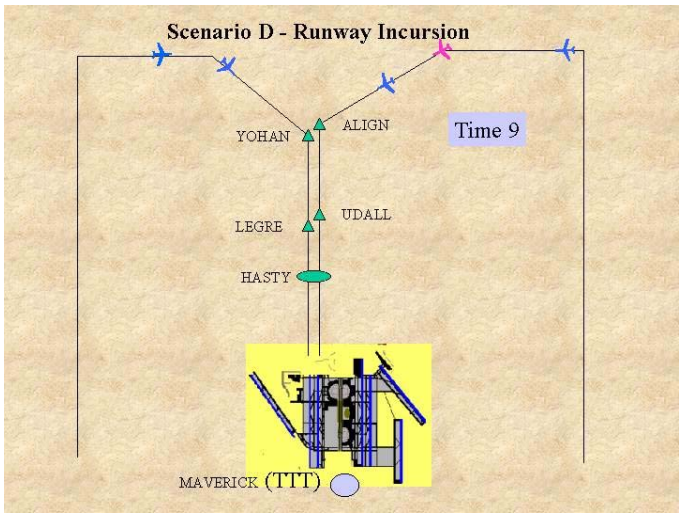

Scenario D - Runway Incursion
YOHAN
ALIGN
Time 4
LEGRE
UDALL
HASTY
MAVERICK (TTT)

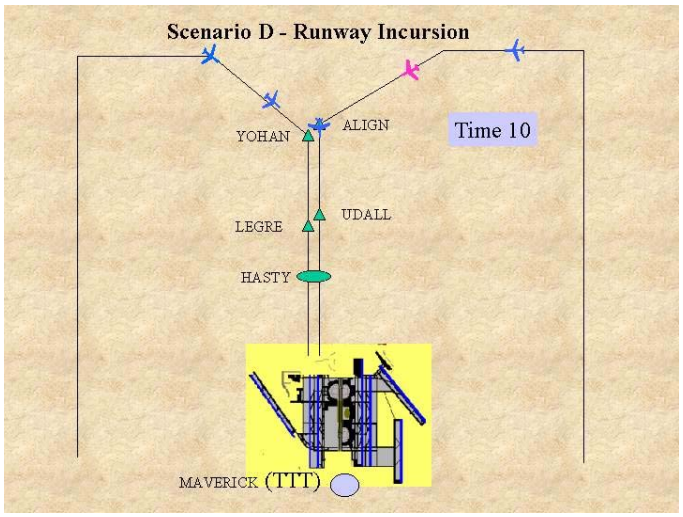

Scenario D - Runway Incursion
YOHAN
ALIGN
Time 5
LEGRE
UDALL
HASTY
MAVERICK (TTT)

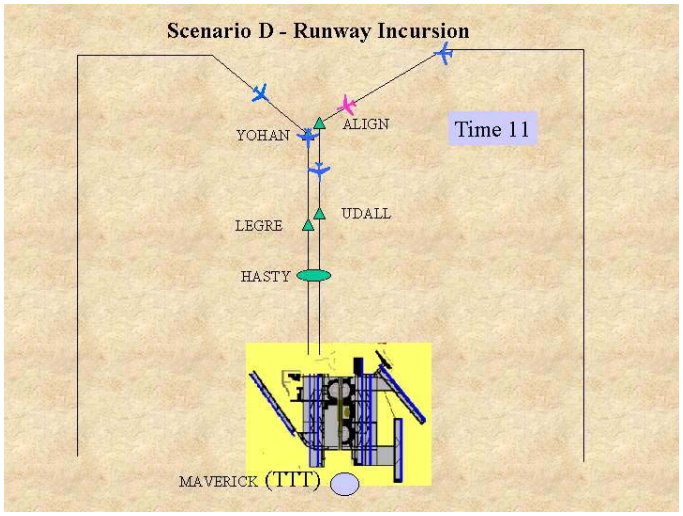

Scenario D - Runway Incursion
YOHAN
ALIGN
Time 6
LEGRE
UDALL
HASTY
MAVERICK (TTT)

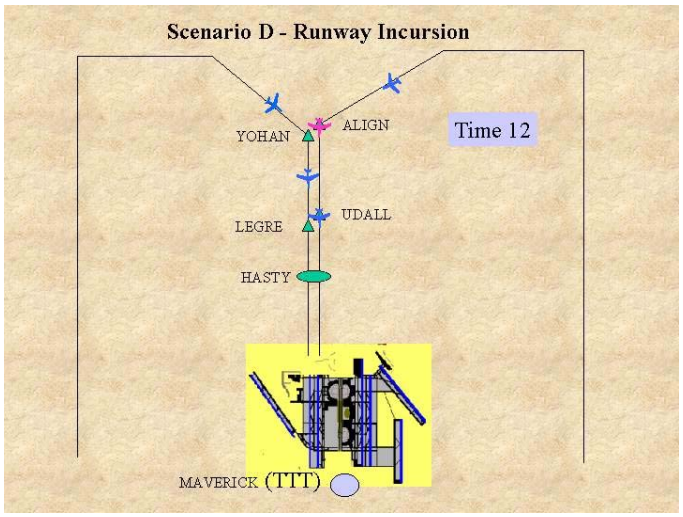

Scenario D - Runway Incursion
YOHAN
ALIGN
Time 7
LEGRE
UDALL
HASTY
MAVERICK (TTT)

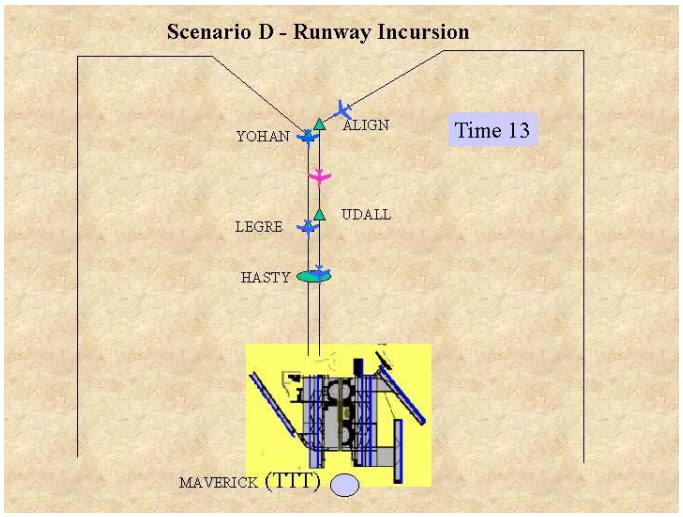

Scenario D - Runway Incursion
YOHAN
ALIGN
Time 8
LEGRE
UDALL
HASTY
MAVERICK (TTT)

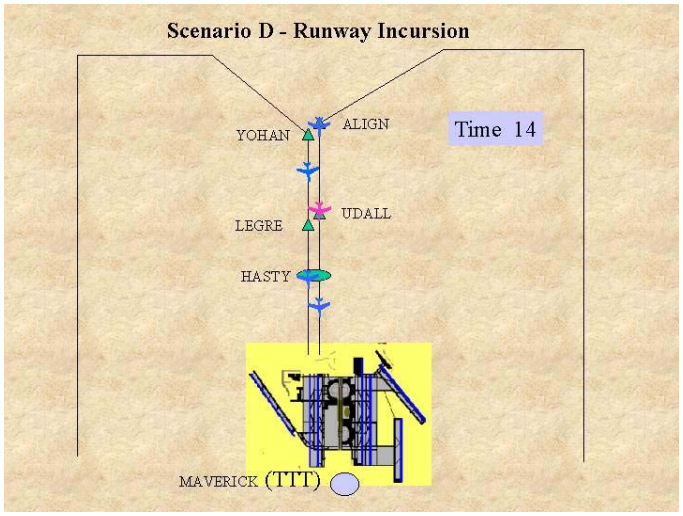

Scenario D - Runway Incursion
YOHAN
ALIGN
Time 9
LEGRE
UDALL
HASTY
MAVERICK (TTT)

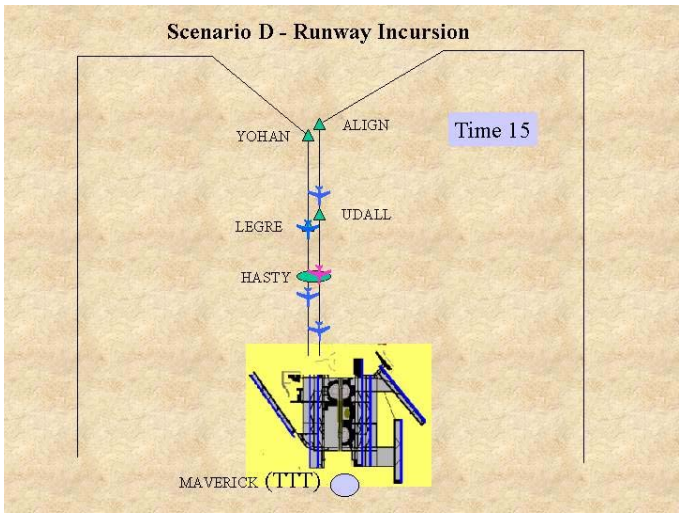

Scenario D - Runway Incursion
YOHAN
ALIGN
Time 10
LEGRE
UDALL
HASTY
MAVERICK (TTT)

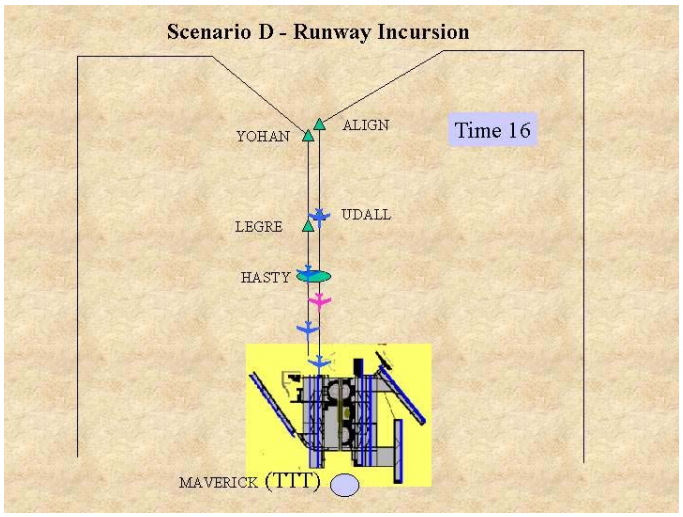

Scenario D - Runway Incursion
YOHAN
ALIGN
Time 11
LEGRE
UDALL
HASTY
MAVERICK (TTT)

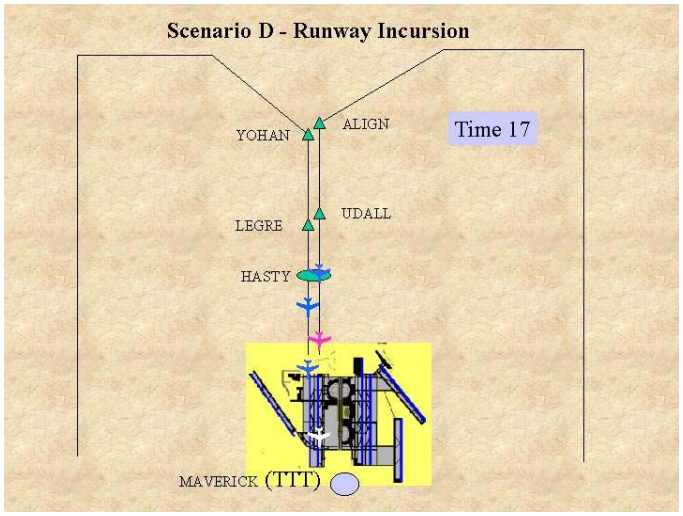

Scenario D - Runway Incursion
YOHAN
ALIGN
Time 12
LEGRE
UDALL
HASTY
MAVERICK (TTT)

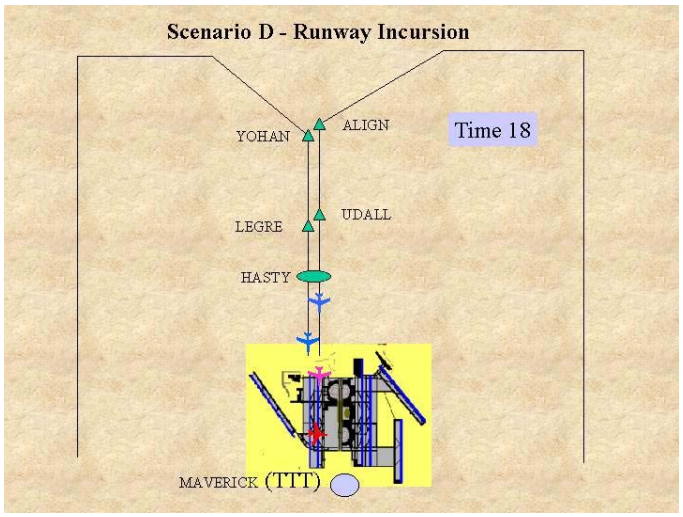

Scenario D - Runway Incursion
YOHAN
ALIGN
Time 13
LEGRE
UDALL
HASTY
MAVERICK (TTT)

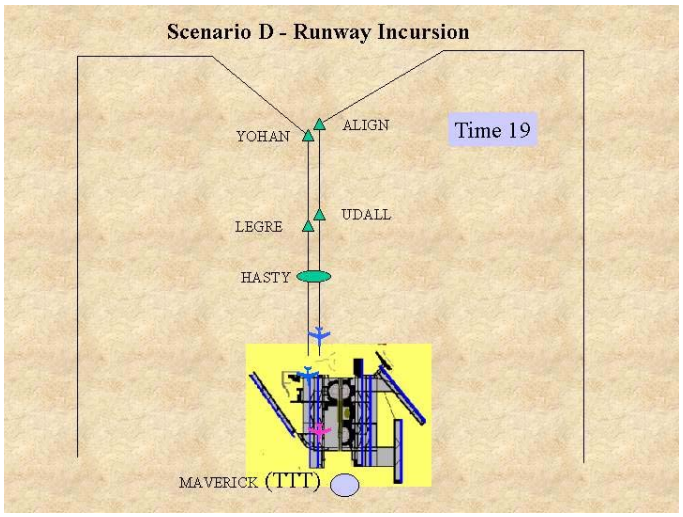

Scenario D - Runway Incursion
YOHAN
ALIGN
Time 14
LEGRE
UDALL
HASTY
MAVERICK (TTT)

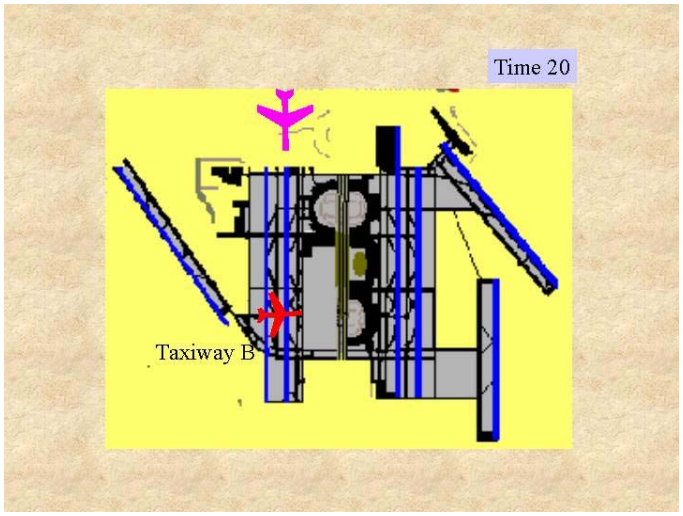

Scenario D - Runway Incursion
YOHAN
ALIGN
Time 15
LEGRE
UDALL
HASTY
MAVERICK (TTT)

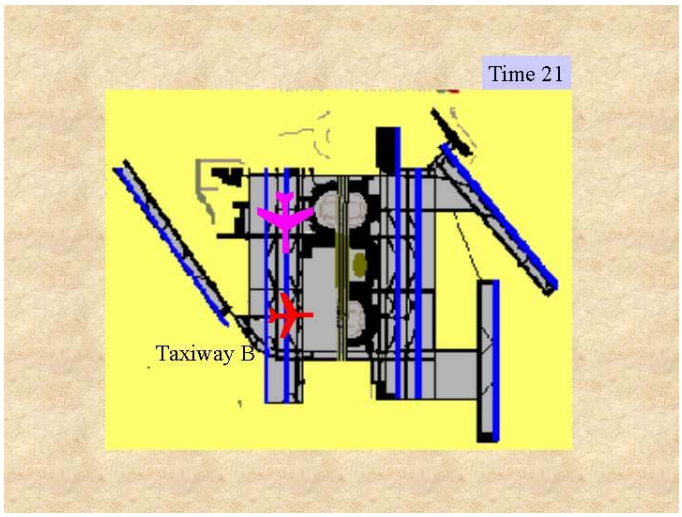

Scenario D - Runway Incursion
YOHAN
ALIGN
Time 16
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Scenario D - Runway Incursion
YOHAN
ALIGN
Time 17
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Scenario D - Runway Incursion
YOHAN
ALIGN
Time 18
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Scenario D - Runway Incursion
YOHAN
ALIGN
Time 19
LEGRE
UDALL
HASTY
MAVERICK (TTT)


Time 20
Taxiway B


Time 21
Taxiway B

Scenario D – Aircraft Data Files

NASA123

	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	downwind		360	250	U	U	175	0
1	downwind	8000	360	250	U	U	175	0
2	downwind		360	250	U	U	175	0
3	downwind	7000	360	250	U	U	175	0
4	downwind		360	250	U	U	175	0
5	downwind	6000	360	250	U	U	175	0
6	downwind		360	230	U	U	175	0
7	turn to base	5000	360	210	U	U	175	0
8	base	5000	270	210	U	U	175	0
9	base	5000	270	210	U	U	175	0
10	turn to DL	5000	270	210	U	U	175	0
11	DL	3000	220	210	U	U	175	0
12	DL	3000	220	210	U	U	175	0
13	ALIGN	3000	175	210	U	U	175	0
14		3000	175	195	5	U	175	0
15	UDALL	3000	175	180	15	U	175	0
16	Taxiway Z	2300	175	180	15	U	175	0
17	Taxiway L						175	0
18	Taxiway L						175	0
19	Taxiway L	603	175	120	30	D	175	0
21	K8	603	090	0	15	D	175	0

Time	Radio Traffic
0	NASA123 - decend to 5000 ft
1	
2	
3	
4	
5	
6	NASA123 - turn lft hdg 270, maintain 210 kts
7	
8	
9	NASA123 - turn lft hdg 220, decend to 3000 ft
10	NASA123 - traffic 1 oclock, 3 miles
11	NASA123 - maintain visual seperation from that traffic
12	NASA123 - turn lft hdg 175, maintain 180 kts to the marker.
13	NASA123, cleared for the ILS app rwy 18L, tower now on 124.15
14	
15	NASA123, cleared to land
16	
17	
18	
20	NASA123, contact gnd

SWA567

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
1	downwind		360	250	U	U	175	0
2	downwind	8000	360	250	U	U	175	0
3	downwind		360	250	U	U	175	0
4	downwind	7000	360	250	U	U	175	0
5	downwind		360	250	U	U	175	0
6	downwind	6000	360	250	U	U	175	0
7	downwind		360	230	U	U	175	0
8	turn to base	5000	360	210	U	U	175	0
9	base	5000	090	210	U	U	175	0
10	base	5000	090	210	U	U	175	0
11	turn to DL	5000	090	210	U	U	175	0
12	DL	3000	140	210	U	U	175	0
13	DL	3000	140	210	U	U	175	0
14	YOHAN	3000	175	210	U	U	175	0
15		3000	175	195	5	U	175	0
16	LEGRE	3000	175	180	15	U	175	0
17	HASTY	2400	175	180	15	U	175	0
18							175	0
19							175	0
20	touchdown	603	175	120	30	D	175	0
20	end of rwy	603	175	0	30	D	175	0

Time	Radio Traffic
0	
1	SWA567 - decend to 5000 ft
2	
3	
4	
5	
6	
7	SWA567 - turn rt hdg 090, maintain 210 kts
8	
9	
10	SWA567 - turn rt hdg 140, decend to 3000 ft
11	SWA567 - traffic 11 oclock, 3 miles
12	SWA567 - maintain visual seperation from that traffic
13	SWA567 - turn rt hdg 175, maintain 180 kts to the marker,
14	SWA567 cleared for the ILS app rwy 18R, tower now on 124.15
15	
16	SWA567, cleared to land
17	
18	
19	
20	SWA567, hold short runway 18L,

Amer1505

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	downwind	8000	360	250	U	U	175	0
1	downwind		360	250	U	U	175	0
2	downwind	8000	360	250	U	U	175	0
3	downwind		360	250	U	U	175	0
4	downwind	6000	360	250	U	U	175	0
5	downwind		360	230	U	U	175	0
6	turn to base	5000	360	210	U	U	175	0
7	base	5000	090	210	U	U	175	0
8	base	5000	090	210	U	U	175	0
9	turn to DL	5000	090	210	U	U	175	0
10	DL	3000	140	210	U	U	175	0
11	DL	3000	140	210	U	U	175	0
12	YOHAN	3000	175	210	U	U	175	0
13		3000	175	195	5	U	175	0
14	LEGRE	3000	175	180	15	U	175	0
15	HASTY	2400	175	180	15	U	175	0
16							175	0
17							175	0
18	touchdown	603	175	120	30	D	175	0
19	end of rwy	603	175	0	30	D	175	0

Time	Radio Traffic
0	Amer1505 - decend to 5000 ft
1	
2	
3	
4	
5	Amer1505 - turn rt hdg 090, maintain 210 kts
6	
7	
8	Amer1505 - turn rt hdg 140, decend to 3000 ft
9	Amer1505 - traffic 11 oclock, 3 miles
10	Amer1505 - maintain visual seperation from that traffic
11	Amer1505 - turn rt hdg 175, maintain 180 kts to the marker.
12	Amer1505, cleared for the ILS app rwy 18r, tower now on 124.15
13	
14	Amer1505, cleared to land
15	
16	
17	
21	Amer1505, hold short runway 18L

United98

	location	alftitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	downwind		360	250	U	U	175	0
1	downwind	7000	360	250	U	U	175	0
2	downwind		360	250	U	U	175	0
3	downwind	6000	360	250	U	U	175	0
4	downwind		360	230	U	U	175	0
5	turn to base	5000	360	210	U	U	175	0
6	base	5000	270	210	U	U	175	0
7	base	5000	270	210	U	U	175	0
8	turn to DL	5000	270	210	U	U	175	0
9	DL	3000	220	210	U	U	175	0
10	DL	3000	220	210	U	U	175	0
11	ALIGN	3000	175	210	U	U	175	0
12		3000	175	195	5	U	175	0
13	UDALL	3000	175	180	15	U	175	0
14	HASTY	2300	175	180	15	U	175	0
15							175	0
16							175	0
17	touchdown	603	175	120	30	D	175	0
21	end of rwy	603	175	0	30	D	175	0

Time	Radio Traffic
0	
1	
2	
3	
4	United98 - turn lft hdg 270, maintain 210 kts
5	
6	
7	United98 - turn lft hdg 220, decend to 3000 ft
8	
9	
10	United98 - turn lft hdg 175, maintain 180 kts to the marker.
11	United98, cleared for the ILS app rwy 18L, tower now on 124.15
12	
13	United98, cleared to land
14	
15	
16	
20	United98, contact gnd

Delta543

	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
2	downwind		360	250	U	U	175	0
3	downwind	8000	360	250	U	U	175	0
4	downwind		360	250	U	U	175	0
5	downwind	7000	360	250	U	U	175	0
6	downwind		360	250	U	U	175	0
7	downwind	6000	360	250	U	U	175	0
8	downwind		360	230	U	U	175	0
9	turn to base	5000	360	210	U	U	175	0
10	base	5000	270	210	U	U	175	0
11	base	5000	270	210	U	U	175	0
12	turn to DL	5000	270	210	U	U	175	0
13	DL	3000	220	210	U	U	175	0
14	DL	3000	220	210	U	U	175	0
15	ALIGN	3000	175	210	U	U	175	0
16		3000	175	195	5	U	175	0
17	UDALL	3000	175	180	15	U	175	0
18	HASTY	2300	175	180	15	U	175	0
19							175	0
20							175	0
21	touchdown	603	175	120	30	D	175	0
22	end of rwy	603	175	0	30	D	175	0

Time	Radio Traffic
2	Delta543 - decend to 5000 ft
3	
4	
5	
6	
7	
8	Delta543 - turn lft hdg 270, maintain 210 kts
9	
10	
11	Delta543 - turn lft hdg 210, decend to 3000 ft
12	Delta543 - traffic 1 oclock, 3 miles
13	Delta543 - maintain visual seperation from that traffic
14	Delta543 - turn lft hdg 175, maintain 180 kts to the marker
15	Delta543, cleared for the ILS app rwy 18L, tower now on 124.15
16	
17	Delta543, cleared to land
18	
19	
20	
21	Delta543, contact gnd
22	

ATC Master Communication Log- Scenario D

Air Traffic Controller Radio Communications

Scripted Radio Calls from Other Aircraft

NASA 123 Suggested Radio Calls

Time 0

American 1505, level at 11000 ft.
Hello American 1505 - descend to 5000 ft
American 1505, descending to 5000 ft
DFW approach, NASA 123
NASA 123, Roger
NASA 123 - descend to 5000 ft
5000 ft, NASA 123

Time 1

Approach, SWA 567, 11000 ft.
SWA 567 - descend to 5000 ft
(Read back clearance)

Time 2

Delta 543 checking in
Roger Delta 543
Delta 543 - descend to 5000 ft
(Read back clearance)

Time 3

Time 4

United 98 - turn left hdg 270, maintain 210 kts
(Read back clearance)

Time 5

American 1505 - turn right hdg 090, maintain 210 kts
(Read back clearance)

Time 6

NASA 123 - turn left hdg 270, maintain 210 kts
(Read back clearance)

Time 7

United 98 - turn left hdg 210, descend to 3000 ft
(Read back clearance)
SWA 567 - turn right hdg 090, maintain 210 kts
(Read back clearance)

Time 8

American 1505 - turn right hdg 140, descend to 3000 ft
(Read back clearance)
Delta 543 - turn left hdg 270, maintain 210 kts
(Read back clearance)

Time 9

NASA 123 - turn left hdg 210, descend to 3000 ft
(Read back clearance)
American 1505 - traffic 11 o'clock, 3 miles
Roger, American 1505 Looking…

Time 10

United 98 - turn left hdg 175, maintain 180 kts to the marker, cleared for the ILS app rwy 18L, tower now on 124.15
(Read back clearance)
American 1505, traffic in sight
Roger American 1505 - maintain visual separation from that traffic
SWA 567 - turn right hdg 140, descend to 3000 ft
(Read back clearance)
NASA 123 - traffic 11 o'clock, 3 miles
Roger, NASA 123 Looking…

Time 11

Delta 543 - turn left hdg 210, descend to 3000 ft
(Read back clearance)
NASA 123 traffic in sight
Roger NASA 123 - maintain visual separation from that traffic
American 1505 - turn right hdg 175, maintain 180 kts to the marker, cleared for the ILS app rwy 18r, tower now on 124.15
(Read back clearance)
SWA 567 - traffic 11 o'clock, 3 miles
Traffic in sight
American 1505, cleared to land
(Read back clearance)

Time 12

NASA 123 - turn left hdg 175, maintain 180 kts to the marker, cleared for the ILS app rwy 18L, tower now on 124.15
(Read back clearance)
SWA 567, traffic in sight
SWA 567 - maintain visual separation from that traffic
(Read back clearance)
Delta 543, traffic 1 o'clock, three miles
Delta 543 looking…

Time 13

Delta 543, traffic in sight
Roger, Delta 543, maintain visual separation from that aircraft
United 98, cleared to land
(Read back clearance)
SWA 567 - turn right hdg 175, maintain 180 kts to the marker, cleared for the ILS app rwy 18r, tower now on 124.15
(Read back clearance)

Time 14

Delta 543 - turn left hdg 175, maintain 180 kts to the marker, cleared for the ILS app rwy 18L, tower now on 124.15
(Read back clearance)
American 1505, cleared to land
(Read back clearance)

Time 15

NASA 123, cleared to land
(Read back clearance)

Time 16

SWA 567, cleared to land
(Read back clearance)

Time 17

Delta 543, cleared to land
(Read back clearance)
United 98, contact ground
(Read back clearance)

Time 18

American 1505, hold short runway 18L
(Read back clearance)
American 1505 continues across Runway 18L, 5000 ft. in front of NASA 123, which is in landing flare.

Time 19

NASA 123, contact ground
(Read back clearance)

Time 20

SWA 567, hold short runway 18L
(Read back clearance)

Time 21

Delta 543, contact ground
(Read back clearance)

Line Oriented Evaluation Scenario E

Taxi and Visual Separation on Takeoff

SVS Aspects Tested: The following CaB SVS CONOPS applications are tested in this scenario.

Ground Operations

- G-2 Aircraft Clearance Awareness De-Conflict Approaches
- G-6 Runway Incursion Detection and Accident Prevention
- G-13 Speed Awareness
- G-15 Taxi Guidance in Low Visibility
- G-18 Taxiway Excursions

Departure

- D-6 VFR Separation
- D-7 Runway/Path Incursion
- D-17 Navigation (SIDs)

Time: 19 minutes

The weather conditions in this scenario are visibility to be less than a quarter mile, with a runway visual range (RVR) of 1000.

This scenario tests the ability of the subject to develop and maintain general situation awareness of multiple aircraft during a normal taxi and departure. The scenario is constructed such that the sequence of each aircraft is one minute spacing from the aircraft ahead during the taxi and departure phase. In addition to the test subjects aircraft (NASA 123) there are four other aircraft taxing for takeoff on runway 18L at DFW, two which will be ahead of NASA 123 and two behind. One aircraft (American 1505) taxis from the east gate area two minutes head of NASA for departure on runway 18L. Southwest 567 taxis two minutes behind. Two aircraft (one ahead – United 98 and the other – Delta 543, behind) are taxing from the west gate area, arriving at the departure end of runway 18L from the opposite (west) side of the airport from NASA 123.

The scenario starts with NASA 123 on the east side of DFW, awaiting clearance to taxi. Radio traffic will indicate that four other aircraft on ground control frequency are taxing to runway 18L. The scenario continues as each aircraft is sequenced for takeoff at one-minute intervals. This scenario would not be realistic in the current ATC environment. One-minute intervals are chosen to allow for sufficient wake turbulence protection.

During the departure phase, NASA 123 must keep United 98 and American 1505 in sight in order to maintain visual separation criteria. This separation is significantly less than would be allowed under IFR separation criteria used today.

SA Measurement

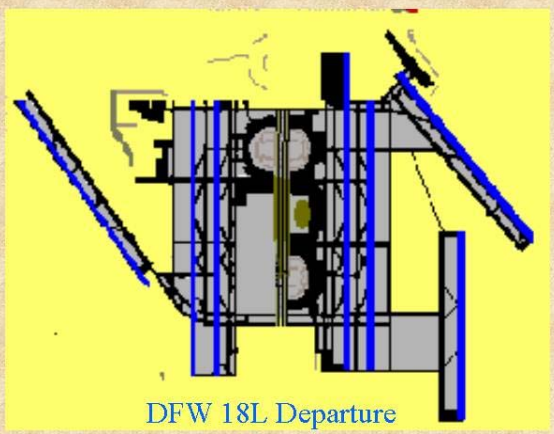
(1) Ground and Flight path adherence – The ability of the pilot to adhere to the cleared taxiways and runways should be measured. This would include ability to maintain the required spacing from other aircraft, adherence to ATC commands, and deviations from clearances. Any incursions onto taxiway F prior to the passage of the crossing aircraft should be measured. Ability of the pilot to adhere to the desired flight path after take-off should be measured. This would include ability to maintain the required spacing from other aircraft, adherence to ATC commands, and deviations from assigned altitudes and headings.

(2) SAGAT – The SA of the pilot should be measured via SAGAT queries at 3 different freeze points (at times 7.30,10.24, and 16.60). Queries should include:

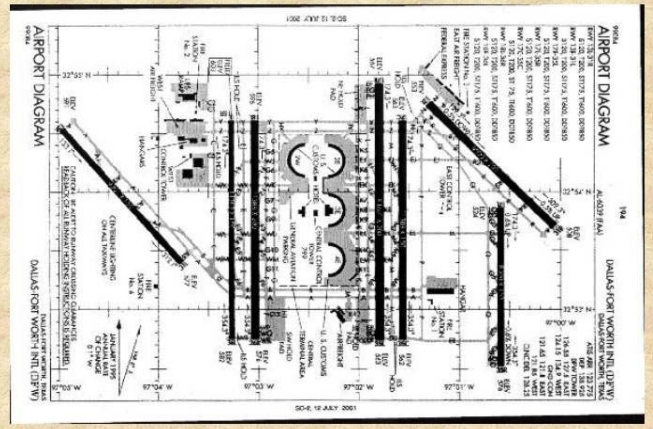
- Query 1 What is the current heading of your aircraft? (stop 3 only)
- Query 2 What is the current altitude (MSL) of your aircraft?(stop 3 only)
- Query 3 What is the indicated airspeed of your aircraft?(stop 3 only)
- Query 4 What is the current rate of climb/descent of your aircraft? (stop 3 only)
- Query 5 What is the attitude of your aircraft (pitch and bank)?(stop 3 only)
- Query 6 What are your current settings (flaps, slats, gear, speed brakes)?
- Query 7 How much fuel do you currently have?(stop 1 only)
- Query 8 What are the current winds (direction, magnitude, gusting to)?
- Query 14 Are you in conformance with your current clearance for this phase of flight?
- Query 15 Is there any conflicting traffic on your current (projected) flight path?
- Query 16 Conflicting traffic is currently located at (bearing and miles)?
- Query 17 Traffic Conflict Type
- Query 18 Is a change in path or altitude needed to avoid obstacles or terrain? (stop 3 only)
- Query 24 Are your systems correctly set-up for this phase of flight?
- Query 31 What is your current rate of closure on the aircraft in front of you? (stop 3 only)
- Query 32 How far to your next waypoint?

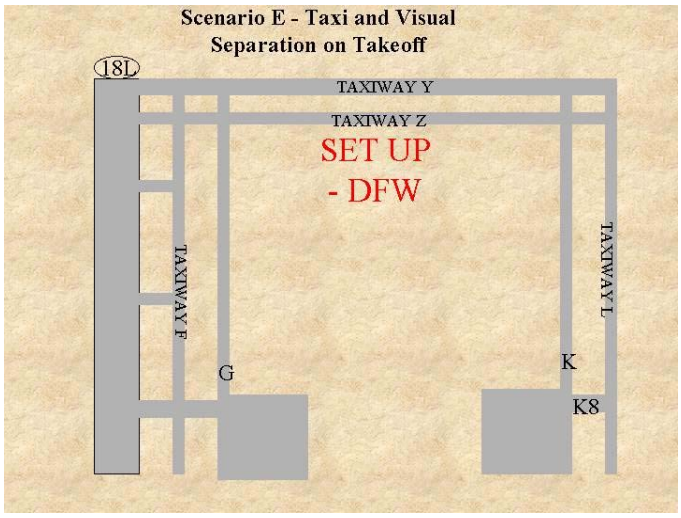
Scenarios for Assessing the Utility of Synthetic Visual Systems (SVS) in Commercial and Business (CaB) Aircraft

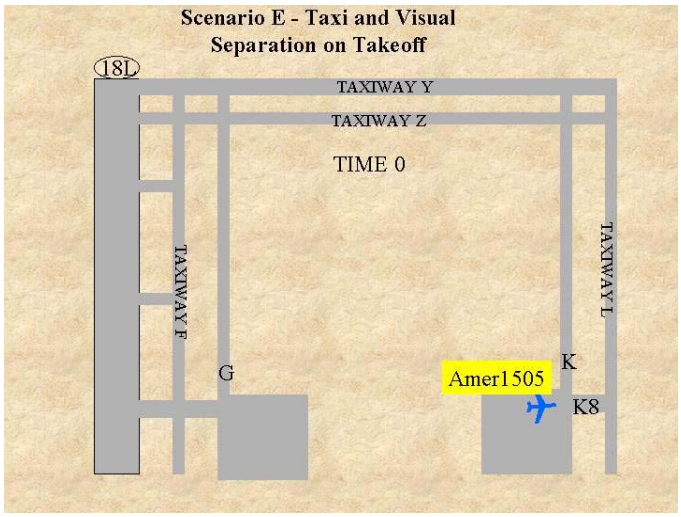
Scenario E - Taxi and Visual Separation on Takeoff

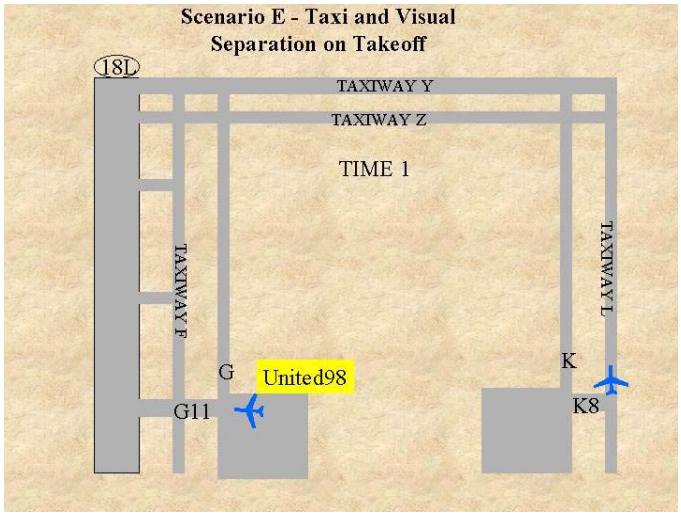


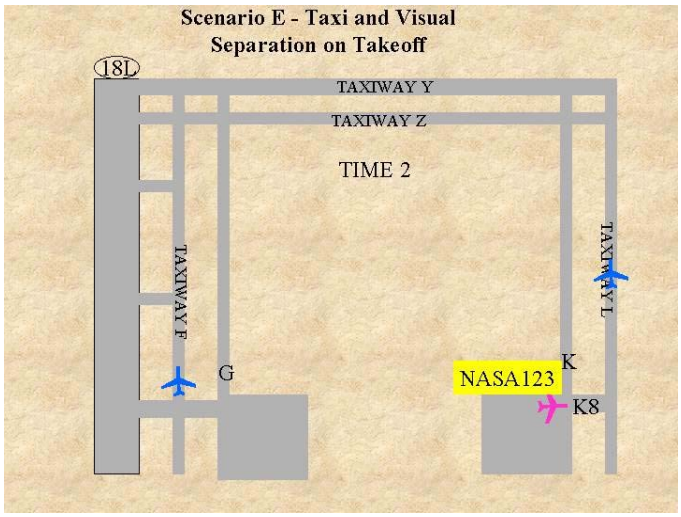
DFW 18L Departure Setup

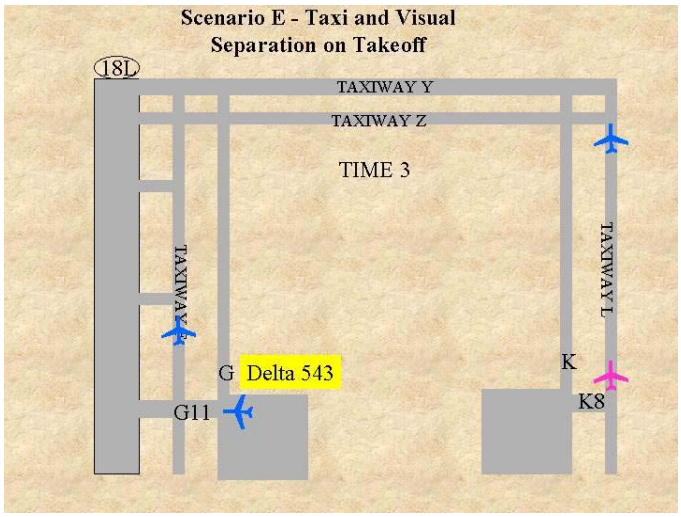


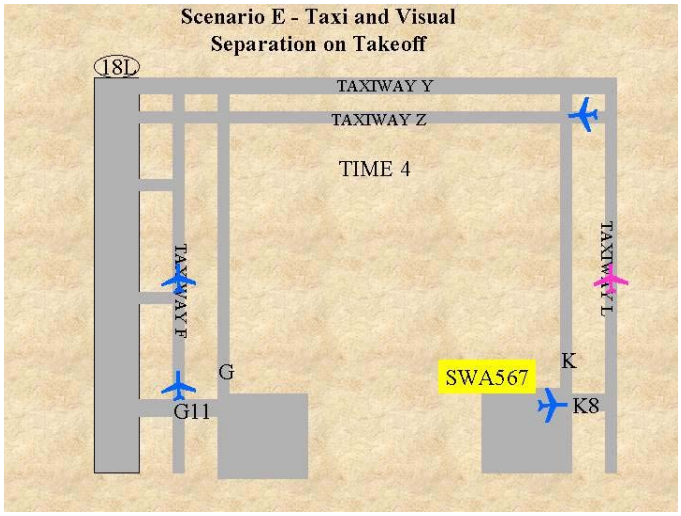

Scenario E - Taxi and Visual
Separation on Takeoff
18L
TAXIWAY Y
TAXIWAY Z
SET UP
- DFW
TAXIWAY F
TAXIWAY L
G
K
K8

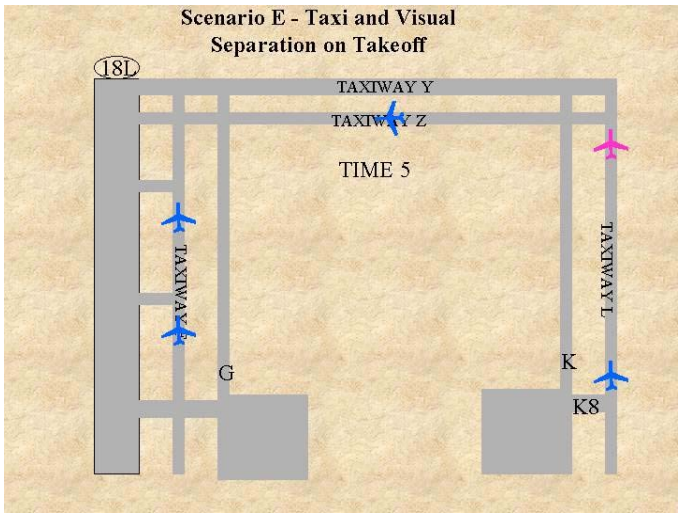

Scenario E - Taxi and Visual
Separation on Takeoff
18L
TAXIWAY Y
TAXIWAY Z
TIME 0
TAXIWAY F
TAXIWAY L
G
K
Amer1505
K8

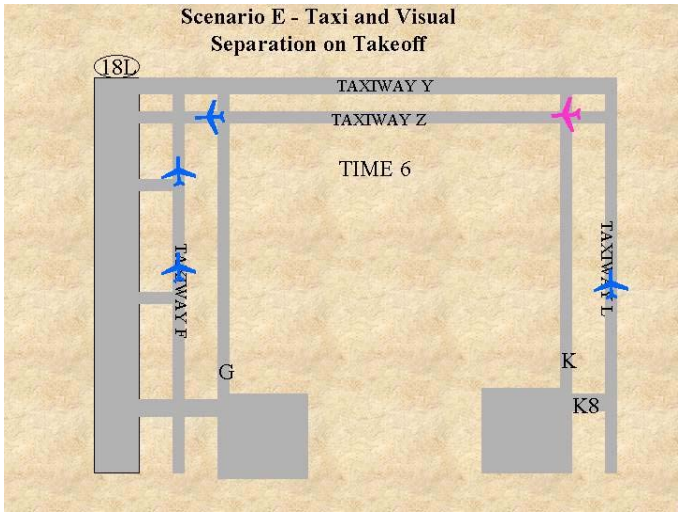

Scenario E - Taxi and Visual
Separation on Takeoff
18L
TAXIWAY Y
TAXIWAY Z
TIME 1
TAXIWAY F
TAXIWAY L
G
United98
G11
K
K8

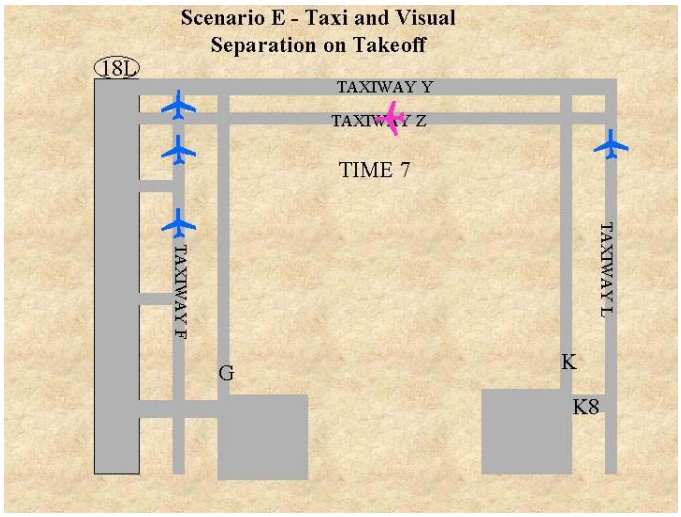

Scenario E - Taxi and Visual Separation on Takeoff
18L
TAXIWAY Y
TAXIWAY Z
TIME 2
TAXIWAY F
TAXIWAY L
G
K
NASA123
K8

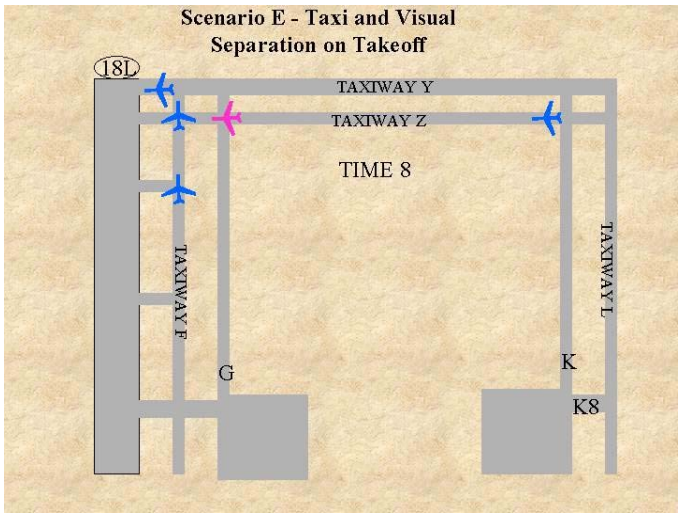

Scenario E - Taxi and Visual Separation on Takeoff
18L
TAXIWAY Y
TAXIWAY Z
TIME 3
TAXIWAY F
TAXIWAY L
G
Delta 543
G11
K
K8

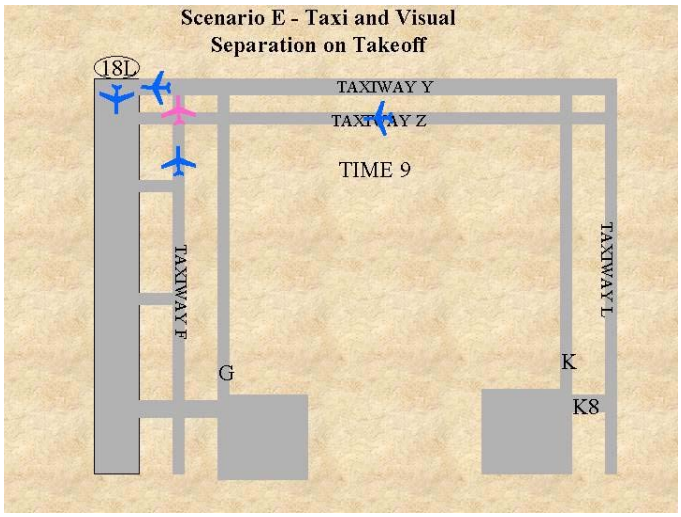

Scenario E - Taxi and Visual Separation on Takeoff
18L
TAXIWAY Y
TAXIWAY Z
TIME 4
TAXIWAY F
TAXIWAY L
G
G11
SWA567
K
K8

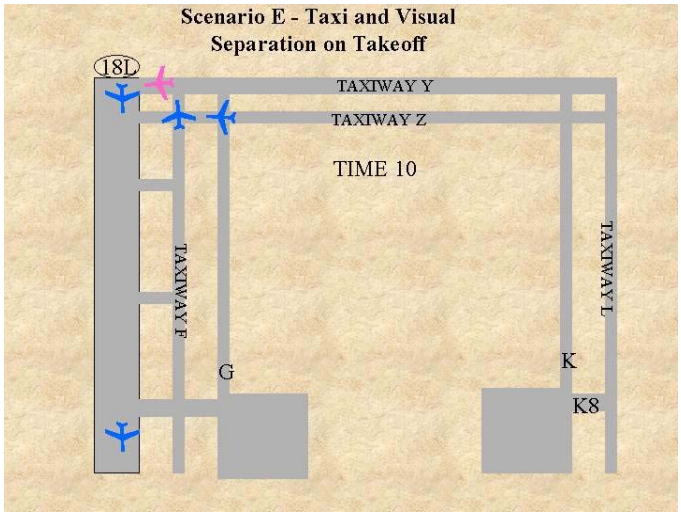

Scenario E - Taxi and Visual
Separation on Takeoff
18L
TAXIWAY Y
TAXIWAY Z
TIME 5
TAXIWAY F
TAXIWAY L
G
K
K8

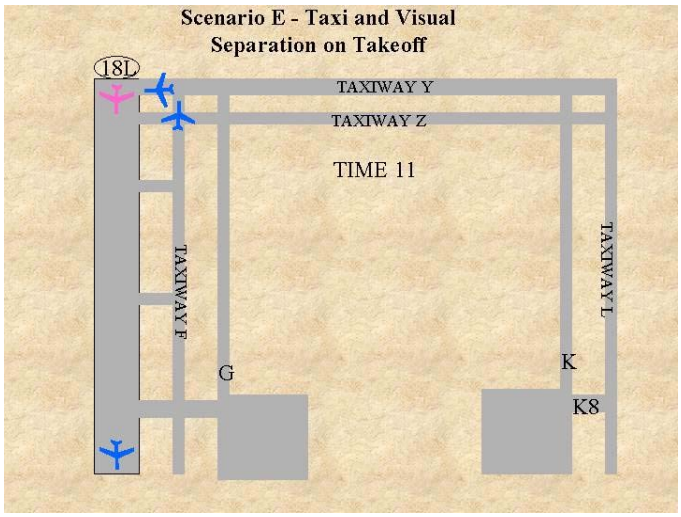

Scenario E - Taxi and Visual
Separation on Takeoff
18L
TAXIWAY Y
TAXIWAY Z
TIME 6
TAXIWAY F
TAXIWAY L
G
K
K8

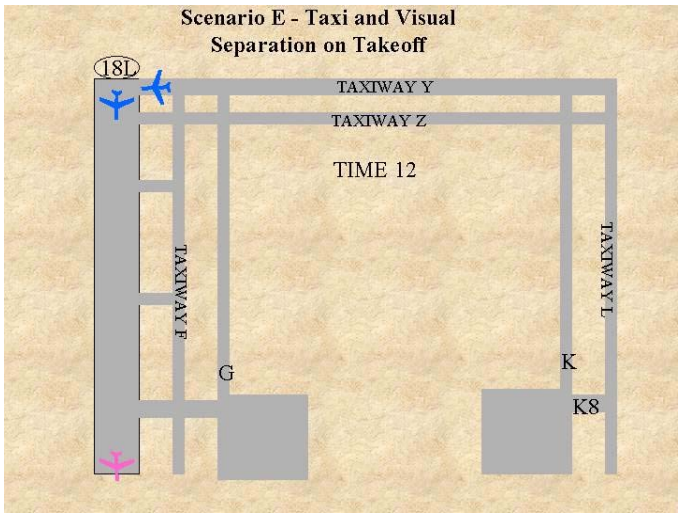

Scenario E - Taxi and Visual
Separation on Takeoff
18L
TAXIWAY Y
TAXIWAY Z
TIME 7
TAXIWAY F
TAXIWAY L
G
K
K8

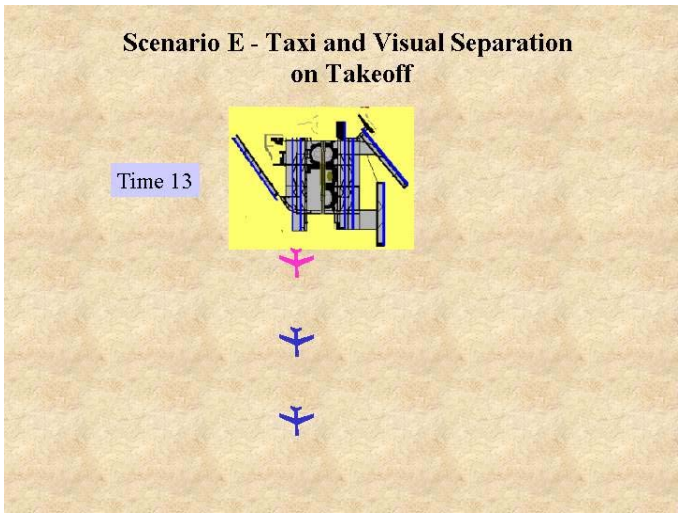

Scenario E - Taxi and Visual
Separation on Takeoff
18L
TAXIWAY Y
TAXIWAY Z
TIME 8
TAXIWAY F
TAXIWAY L
G
K
K8


Scenario E - Taxi and Visual
Separation on Takeoff
18L
TAXIWAY Y
TAXIWAY Z
TIME 9
TAXIWAY F
TAXIWAY L
G
K
K8


Scenario E - Taxi and Visual
Separation on Takeoff
18L
TAXIWAY Y
TAXIWAY Z
TIME 10
TAXIWAY F
TAXIWAY L
G
K
K8

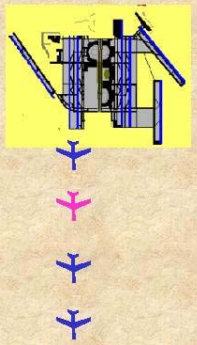

Scenario E - Taxi and Visual Separation on Takeoff
18L
TAXIWAY Y
TAXIWAY Z
TIME 11
TAXIWAY F
TAXIWAY L
G
K
K8


Scenario E - Taxi and Visual Separation on Takeoff
18L
TAXIWAY Y
TAXIWAY Z
TIME 12
TAXIWAY F
TAXIWAY L
G
K
K8


Scenario E - Taxi and Visual Separation on Takeoff
Time 13

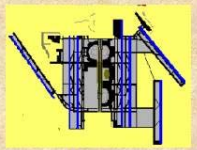
Scenario E - Taxi and Visual Separation on Takeoff

Time 14



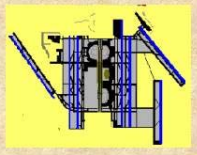
Scenario E - Taxi and Visual Separation on Takeoff

Time 15



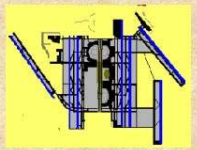
Scenario E - Taxi and Visual Separation on Takeoff

Time 16



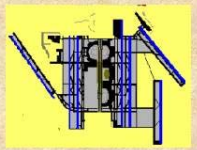
Scenario E - Taxi and Visual Separation on Takeoff

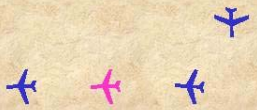
Time 17



Scenario E - Taxi and Visual Separation on Takeoff

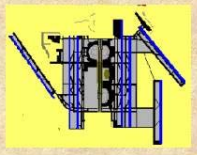
Time 18





Scenario E - Taxi and Visual Separation on Takeoff

Time 19



Scenario E – Aircraft Data

Amer1505

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	K8	603	090	0	15	D	175	0
1	Taxiway L	603	360	20	15	D	175	0
2	Taxiway L	603	360	20	15	D	175	0
3	Taxiway L	603	360	20	15	D	175	0
4	Taxiway Z	603	270	20	15	D	175	0
5	Taxiway Z	603	270	20	15	D	175	0
6	Taxiway Z	603	270	20	15	D	175	0
7	Taxiway F	603	360	20	15	D	175	0
8	Taxiway Y	603	270	20	15	D	175	0
9	Rwy 18L	603	180	0	15	D	175	0
10	Rwy 18L	603	180	180	15	D	175	0
11	Heading 185	1000	185	220	15	U	175	0
12	Heading 185	3500	185	250	5	U	175	0
13	Heading 185	6000	185	250	U	U	175	0
14	Heading 185	8500	185	250	U	U	175	0
15	Heading 270	10000	270	250	U	U	175	0
16	Heading 270	10000	270	250	U	U	175	0
17	Heading 270	10000	270	250	U	U	175	0
18								
19								
20								

Time	Radio Traffic - Initial Call "Amer1505, Kilo8, Information B to taxi"
0	Amer1505, DFW gnd - taxi to Rwy 18L via Lima, Zulu, Foxtrot. Contact West Gnd on the Bridge
1	
2	
3	
4	
5	Amer1505, DFW Gnd - Hold short of runway 18L on Yankee
6	
7	Amer1505, contact twr
8	Amer1505, taxi into position Rwy 18L and hold
9	Amer1505, cleared for takeoff
10	
11	
12	Amer1505, contact departure control
13	Amer1505, DFW departure, maintain 10000ft
14	Amer1505, turn right heading 270
15	
16	
17	
18	
19	
20	
21	

United98

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
1	G11	603	270	0	15	D	175	0
2	Taxiway F	603	360	10	15	D	175	0
3	Taxiway F	603	360	10	15	D	175	0
4	Taxiway F	603	360	10	15	D	175	0
5	Taxiway F	603	360	10	15	D	175	0
6	Taxiway F	603	360	10	15	D	175	0
7	Taxiway F	603	360	10	15	D	175	0
8	Taxiway F	603	360	10	15	D	175	0
9	Taxiway Y	603	270	10	15	D	175	0
10	Rwy 18L	603	180	0	15	D	175	0
11	Rwy 18L	603	180	180	15	D	175	0
12	Heading 185	1000	185	220	15	U	175	0
13	Heading 185	3500	185	250	5	U	175	0
14	Heading 185	6000	185	250	U	U	175	0
15	Heading 185	8500	185	250	U	U	175	0
16	Heading 270	10000	270	250	U	U	175	0
17	Heading 270	10000	270	250	U	U	175	0
18	Heading 270	10000	270	250	U	U	175	0
19								
20								
21								

Time	Radio Traffic - Initial Call "United 98, information B, G11, taxi"
1	United98, DFW gnd - taxi to Rwy 18L via Foxtrot, Yankee
2	
3	
4	
5	
6	United98, Follow the American 757 on Zulu
7	
8	United98, contact twr
9	United98, taxi into position Rwy 18L and hold
10	United98, cleared for takeoff
11	
12	
13	United98, contact departure control
14	United98, DFW departure, maintain 10000ft
15	United98, turn right heading 270
16	
17	
18	
19	
20	
21	

NASA123

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
2	K8	603	090	0	15	D	175	0
3	Taxiway L	603	360	20	15	D	175	0
4	Taxiway L	603	360	20	15	D	175	0
5	Taxiway L	603	360	20	15	D	175	0
6	Taxiway Z	603	270	20	15	D	175	0
7	Taxiway Z	603	270	20	15	D	175	0
8	Taxiway Z	603	270	20	15	D	175	0
9	Taxiway F	603	360	20	15	D	175	0
10	Taxiway Y	603	270	20	15	D	175	0
11	Rwy 18L	603	180	0	15	D	175	0
12	Rwy 18L	603	180	180	15	D	175	0
13	Heading 185	1000	185	220	15	U	175	0
14	Heading 185	3500	185	250	5	U	175	0
15	Heading 185	6000	185	250	U	U	175	0
16	Heading 185	8500	185	250	U	U	175	0
17	Heading 270	10000	270	250	U	U	175	0
18	Heading 270	10000	270	250	U	U	175	0
19	Heading 270	10000	270	250	U	U	175	0
20								
21								
22								

Time	Radio Traffic - Initial Call "NASA123, information B, K8, taxi"
2	NASA123, DFW gnd - taxi to Rwy 18L via Lima, Zulu, Foxtrot. Contact West Gnd on the Bridge
3	
4	
5	
6	
7	NASA123, DFW Gnd - Follow the United 737 on Foxtrot to 18L
8	
9	NASA123, contact twr
10	NASA123, taxi into position Rwy 18L and hold
11	NASA123, cleared for takeoff
12	
13	
14	NASA123, contact departure control
15	NASA123, DFW departure, maintain 10000ft
16	NASA123, turn right heading 270
17	
18	
19	
20	
21	

Delta543

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
3	G11	603	090	0	15	D	175	0
4	Taxiway F	603	360	10	15	D	175	0
5	Taxiway F	603	360	10	15	D	175	0
6	Taxiway F	603	360	10	15	D	175	0
7	Taxiway F	603	270	10	15	D	175	0
8	Taxiway F	603	270	10	15	D	175	0
9	Taxiway F	603	270	10	15	D	175	0
10	Taxiway F	603	360	10	15	D	175	0
11	Taxiway Y	603	270	10	15	D	175	0
12	Rwy 18L	603	180	0	15	D	175	0
13	Rwy 18L	603	180	180	15	D	175	0
14	Heading 185	1000	185	220	15	U	175	0
15	Heading 185	3500	185	250	5	U	175	0
16	Heading 185	6000	185	250	U	U	175	0
17	Heading 185	8500	185	250	U	U	175	0
18	Heading 270	10000	270	250	U	U	175	0
19	Heading 270	10000	270	250	U	U	175	0
20	Heading 270	10000	270	250	U	U	175	0
21								
22								
23								

Time	Radio Traffic - Initial Call "Delta 543, G11, information B, taxi"
3	Delta543, DFW gnd - taxi to Rwy 18L via Foxtrot, Yankee
4	
5	
6	
7	
8	Delta543, DFW Gnd - follow the NASA 757 on Z to 18L
9	
10	Delta543, contact twr
11	Delta543, taxi into position Rwy 18L and hold
12	Delta543, cleared for takeoff
13	
14	
15	Delta543, contact departure control
16	Delta543, DFW departure, maintain 10000ft
17	Delta543, turn right heading 270
18	
19	
20	
21	

SWA567

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
4	K8	603	090	0	15	D	175	0
5	Taxiway L	603	360	20	15	D	175	0
6	Taxiway L	603	360	20	15	D	175	0
7	Taxiway L	603	360	20	15	D	175	0
8	Taxiway Z	603	270	20	15	D	175	0
9	Taxiway Z	603	270	20	15	D	175	0
10	Taxiway Z	603	270	20	15	D	175	0
11	Taxiway F	603	360	20	15	D	175	0
12	Taxiway Y	603	270	20	15	D	175	0
13	Rwy 18L	603	180	0	15	D	175	0
14	Rwy 18L	603	180	180	15	D	175	0
15	Heading 185	1000	185	220	15	U	175	0
16	Heading 185	3500	185	250	5	U	175	0
17	Heading 185	6000	185	250	U	U	175	0
18	Heading 185	8500	185	250	U	U	175	0
19	Heading 270	10000	270	250	U	U	175	0
20	Heading 270	10000	270	250	U	U	175	0
21	Heading 270	10000	270	250	U	U	175	0
22								
23								
24								

Time	Radio Traffic - Initial call "SW567, information B, K8, taxi"
4	SWA567, DFW gnd - taxi to Rwy 18L via Lima, Zulu, Foxtrot. Contact West Gnd on the Bridge
5	
6	
7	
8	
9	SWA567, DFW Gnd - follow the delta 767 on F for 18L
10	
11	SWA567, contact twr
12	SWA567, taxi into position Rwy 18L and hold
13	SWA567, cleared for takeoff
14	
15	
16	SWA567, contact departure control
17	SWA567, DFW departure, maintain 10000ft
18	SWA567, turn right heading 270
19	
20	
21	

ATC Master Communication Log- Scenario E

Air Traffic Controller Radio Communications

Scripted Radio Calls from Other Aircraft

NASA 123 Radio Suggested Radio Calls

Time 0

Initial Call "Amer1505, Kilo8, Information B to taxi"
Amer1505, DFW gnd - taxi to Rwy 18L via Lima, Zulu, Foxtrot.
(Reply)

Time 1

Initial Call "United 98, information B, G11, taxi"
United98, DFW gnd - taxi to Rwy 18L via Foxtrot, Yankee
(Reply)

Time 2

Initial Call "NASA123, information B, K8, taxi"
NASA123, DFW gnd - taxi to Rwy 18L via Lima, Zulu, Foxtrot.
(Reply)

Time 3

Initial Call "Delta 543, G11, information B, taxi"
Delta543, DFW gnd - taxi to Rwy 18L via Foxtrot, Yankee
(Reply)

Time 4

Initial call "SW567, information B, K8, taxi"
SWA567, DFW gnd - taxi to Rwy 18L via Lima, Zulu, Foxtrot.
(Reply)

Time 5

Amer1505, DFW Gnd - Hold short of runway 18L on Yankee
(Reply)

Time 6

United98, Follow the American 757 on Zulu
(Reply)

Time 7

Amer1505, contact twr
(Reply)
NASA123, DFW Gnd - Follow the United 737 on Foxtrot to 18L
(Reply)

Time 8

United98, contact twr
(Reply)
Delta543, DFW Gnd - follow the NASA 757 on Z to 18L
(Reply)

Time 9

NASA123, contact twr
(Reply)
SWA567, DFW Gnd - follow the delta 767 on F for 18L
(Reply)

Time 10

United98, cleared for takeoff
(Reply)
NASA123, taxi into position Rwy 18L and hold
(Reply)

Time 11

NASA123, cleared for takeoff
(Reply)
Delta543, taxi into position Rwy 18L and hold
(Reply)

Time 12

Amer1505, contact departure control
(Reply)
Delta543, cleared for takeoff
(Reply)
SWA567, taxi into position Rwy 18L and hold
(Reply)

Time 13

United98, contact departure control
(Reply)
SWA567, cleared for takeoff
(Reply)

Time 14

NASA123, contact departure control
(Reply)

Time 15

United98, turn right heading 270
(Reply)
NASA123, DFW departure, maintain 10000ft
(Reply)

Time 16

NASA123, turn right heading 270
(Reply)
Delta543, DFW departure, maintain 10000ft
(Reply)

Time 17

Delta543, turn right heading 270
(Reply)
SWA567, DFW departure, maintain 10000ft
(Reply)

Time 18

SWA567, turn right heading 270
(Reply)

Line Oriented Evaluation Scenario F

Taxi, Runway Incursion and Departure Conflict

SVS Aspects Tested: The following CaB SVS CONOPS applications are tested in this scenario.

Ground Operations

- G-2 Aircraft Clearance Awareness De-Conflict Approaches
- G-6 Runway Incursion Detection and Accident Prevention
- G-13 Speed Awareness
- G-15 Taxi Guidance in Low Visibility
- G-18 Taxiway Excursions

Departure

- D-6 VFR Separation
- D-7 Runway/Path Incursion
- D-17 Navigation (SIDs)

Time: 19 minutes

The weather conditions in this scenario are visibility to be less than a quarter mile, with a runway visual range (RVR) of 1000. In order to make the scenario more realistic, DFW ground control is divided into two frequencies so aircraft cannot hear each other's clearances.

This scenario tests the ability of the subject to develop and maintain general situation awareness of multiple aircraft during a normal taxi and departure. However, two non-normal events are built into this scenario. The scenario is constructed such that the sequence of each aircraft is one minute spacing from the aircraft ahead during the taxi and departure phase. In addition to the test subjects aircraft (NASA 123) there are three other aircraft taxiing for takeoff on runway 18L at DFW, two which will be ahead of NASA 123 and one behind. One aircraft (American 228) taxis from the east gate area two minutes head of NASA for departure on runway 18L, the other – United 325, is one minute behind and cleared to taxi to runway 17R. One aircraft, Northwest 987, is taxiing from the west gate area for runway 18L to arrive at the departure end of runway 18L from the opposite (west) side of the airport from NASA 123. NASA 123 cannot hear the taxi instructions issued to this aircraft.

The scenario starts with NASA 123 on the east side of DFW, awaiting clearance to taxi. Radio traffic will indicate that two other aircraft are on ground control frequency, one taxiing to runway 18L and the other to 17R. The scenario continues as aircraft are sequenced for takeoff at one-minute intervals. This scenario would not be realistic in the current ATC environment. One-minute intervals are chosen to allow for sufficient wake turbulence protection. During the taxi phase, an aircraft (Southwest 753) is cleared to land on runway 18R and instructed to hold short of 18L. As NASA 123 is on takeoff roll, Southwest 753 enters runway 18L at midfield. This is the first non-normal situation.

During the departure phase, NASA 123 must keep United 98 and American 1505 in sight in order to maintain visual separation criteria. This separation is significantly less than would be allowed under IFR separation criteria used today. During this phase, United 325 (which has taken off from runway 17R one minute ahead of NASA 123) has an engine failure and drifts into NASA 123's flight path during the initial climb out. This is the second non-normal situation.

SA Measurement

(1) Ground and Flight path adherence – The ability of the pilot to adhere to the cleared taxiways and runways should be measured. This would include ability to maintain the required spacing from other aircraft, adherence to ATC commands, and deviations from clearances. Any movement of the aircraft down the runway while the intruder aircraft is present on the runway should be measured. Verbalizations or other actions indicating detection of the intruder aircraft should be measured.

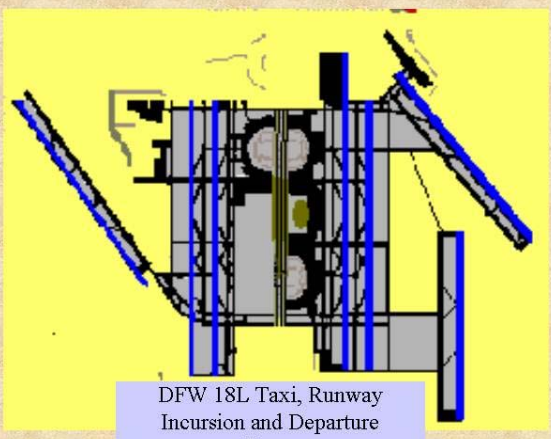
Ability of the pilot to adhere to the desired flight path after take-off should be measured. This would include ability to maintain the required spacing from other aircraft, adherence to ATC commands, and deviations from assigned altitudes and headings. Closest passing distance of the intruder aircraft should be measured. Verbalizations, flight path deviations, or other actions indicating detection of the intruder aircraft should be measured.

(2) SAGAT – The SA of the pilot should be measured via SAGAT queries at 3 different freeze points (at times 6.70, 11.00, and 13.20). Queries should include:

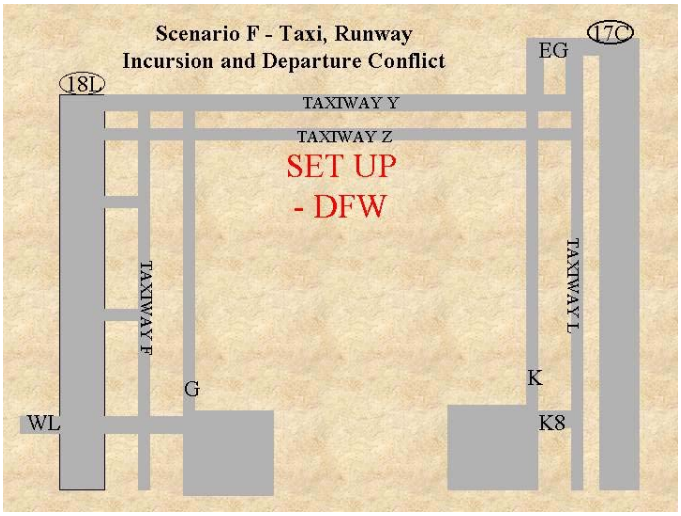
- Query 1 What is the current heading of your aircraft? (stop 3 only)
- Query 2 What is the current altitude (MSL) of your aircraft?(stop 3 only)
- Query 3 What is the indicated airspeed of your aircraft?(stop 3 only)
- Query 4 What is the current rate of climb/descent of your aircraft? (stop 3 only)
- Query 5 What is the attitude of your aircraft (pitch and bank)?(stop 3 only)
- Query 6 What are your current settings (flaps, slats, gear, speed brakes)?
- Query 7 How much fuel do you currently have?(stop 1 only)
- Query 8 What are the current winds (direction, magnitude, gusting to)?
- Query 14 Are you in conformance with your current clearance for this phase of flight?
- Query 15 Is there any conflicting traffic on your current (projected) flight path?
- Query 16 Conflicting traffic is currently located at (bearing and miles)?
- Query 17 Traffic Conflict Type
- Query 18 Is a change in path or altitude needed to avoid obstacles or terrain? (stop 3 only)
- Query 24 Are your systems correctly set-up for this phase of flight?
- Query 31 What is your current rate of closure on the aircraft in front of you?
- Query 32 How far to your next waypoint?

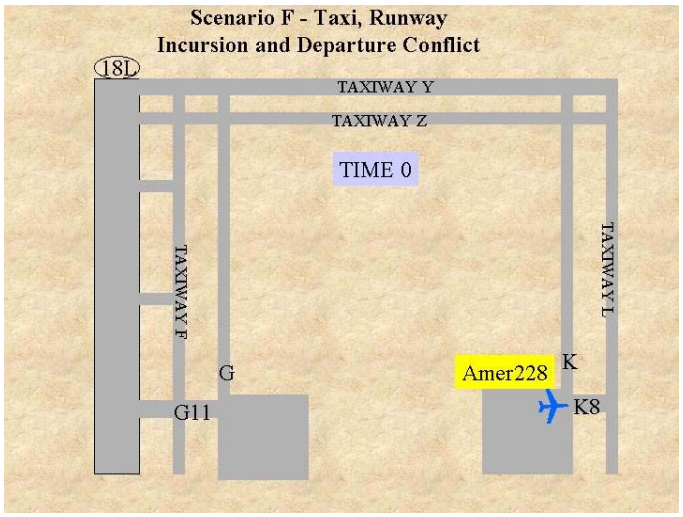
Scenarios for Assessing the Utility of Synthetic Visual Systems (SVS) in Commercial and Business (CaB) Aircraft

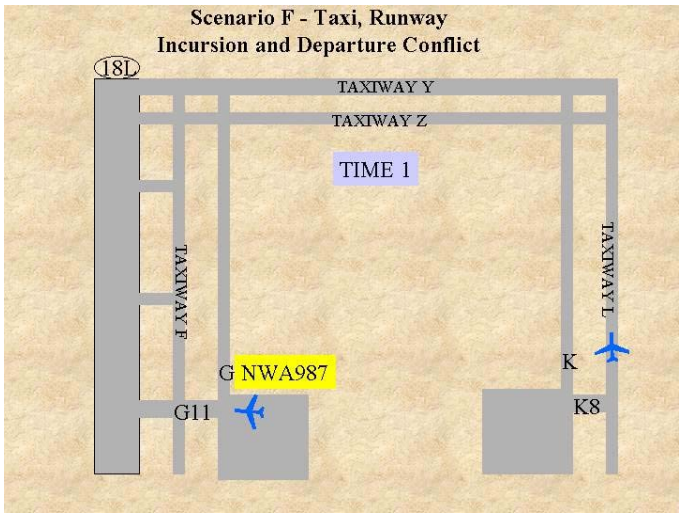
Scenario F - Runway Incursion and Departure Conflict Setup

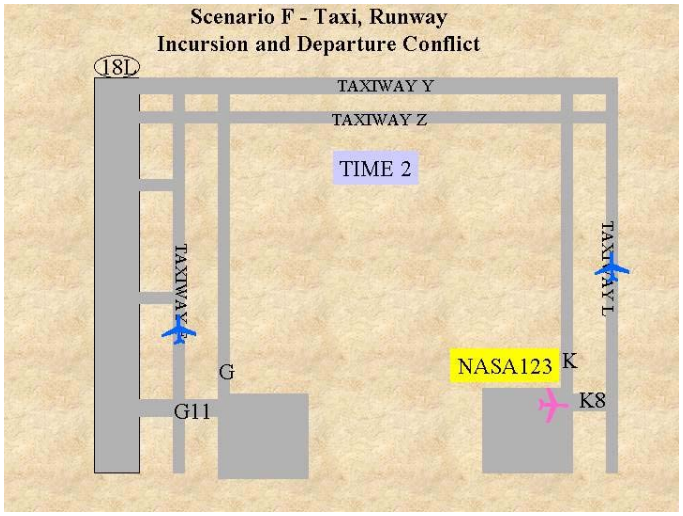


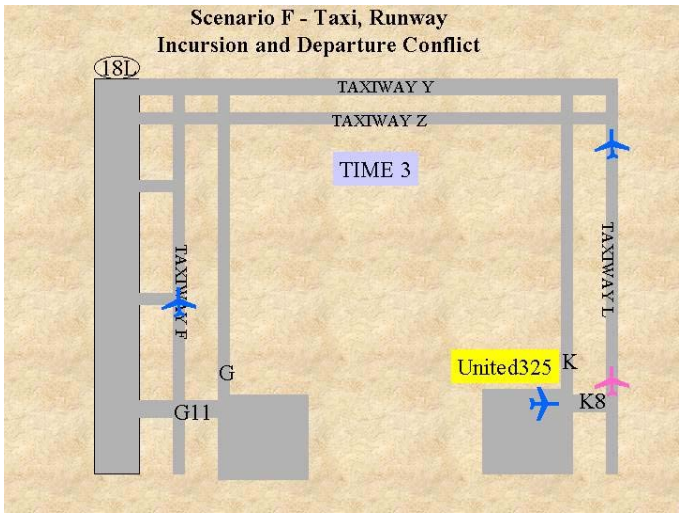
DFW 18L Taxi, Runway Incursion and Departure Conflict Setup

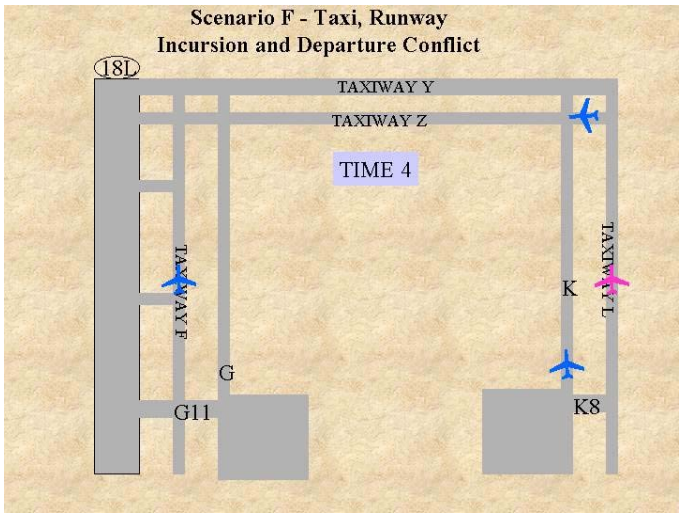


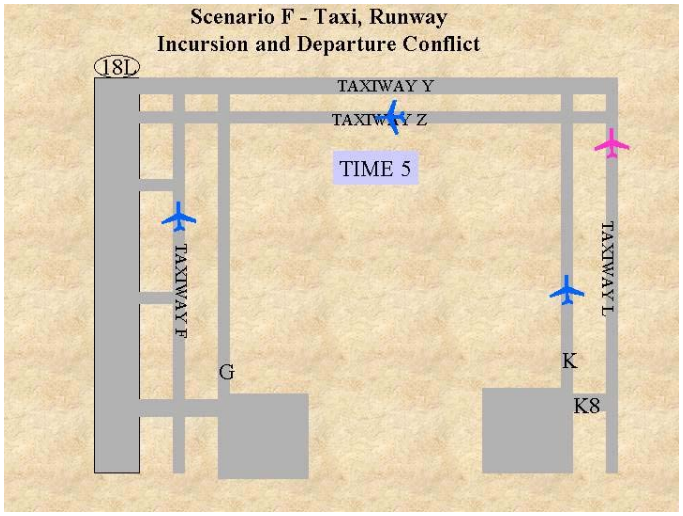

Scenario F - Taxi, Runway
Incursion and Departure Conflict
18L
TAXIWAY Y
TAXIWAY Z
TIME 0
TAXIWAY F
TAXIWAY L
G
G11
Amer228
K
K8

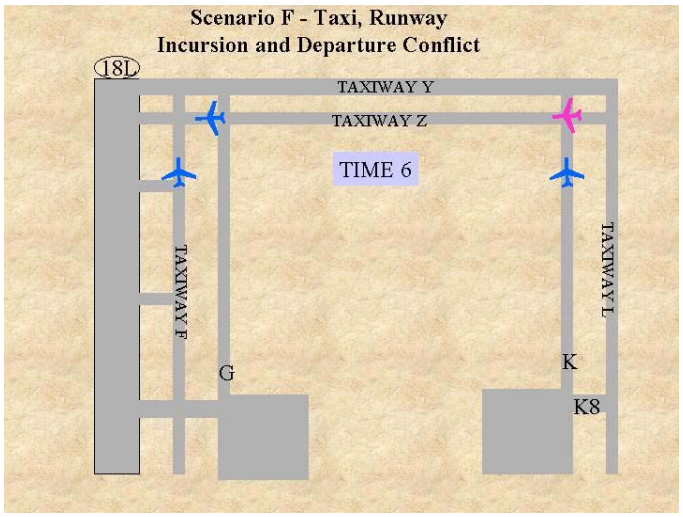

Scenario F - Taxi, Runway
Incursion and Departure Conflict
18L
TAXIWAY Y
TAXIWAY Z
TIME 1
TAXIWAY F
TAXIWAY L
G
NWA987
G11
K
K8

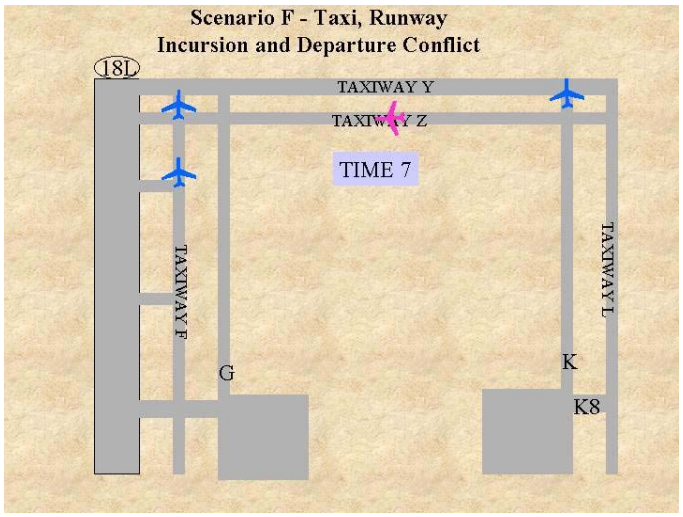

Scenario F - Taxi, Runway
Incursion and Departure Conflict
18L
TAXIWAY Y
TAXIWAY Z
TIME 2
TAXIWAY F
TAXIWAY L
G
G11
NASA123
K
K8

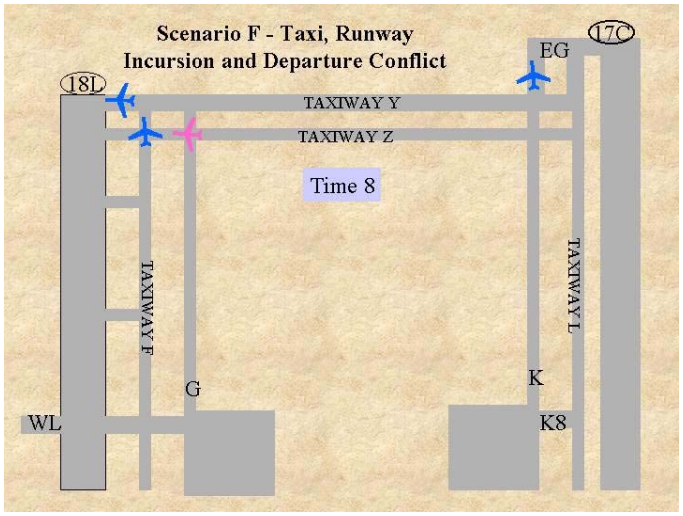

Scenario F - Taxi, Runway
Incursion and Departure Conflict
18L
TAXIWAY Y
TAXIWAY Z
TIME 3
TAXIWAY F
TAXIWAY L
United325
K
G
K8
G11

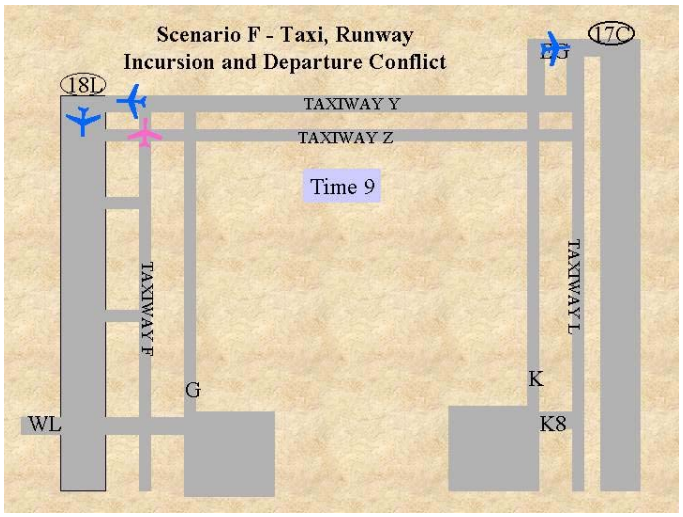

Scenario F - Taxi, Runway
Incursion and Departure Conflict
18L
TAXIWAY Y
TAXIWAY Z
TIME 4
TAXIWAY F
TAXIWAY L
K
G
K8
G11

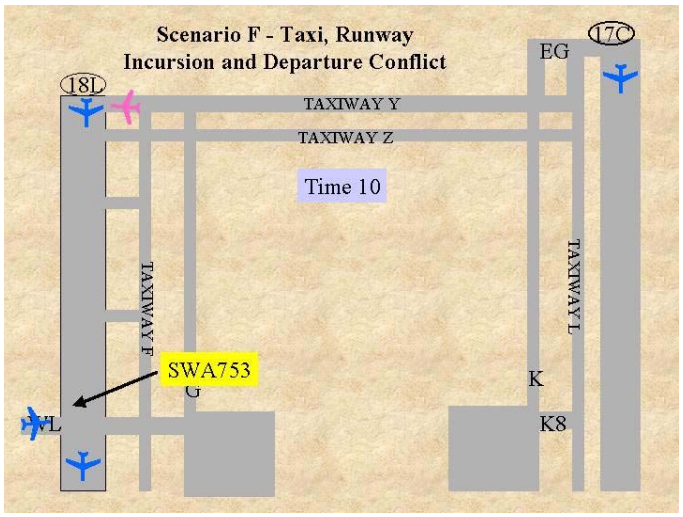

Scenario F - Taxi, Runway
Incursion and Departure Conflict
18L
TAXIWAY Y
TAXIWAY Z
TIME 5
TAXIWAY F
TAXIWAY L
K
G
K8

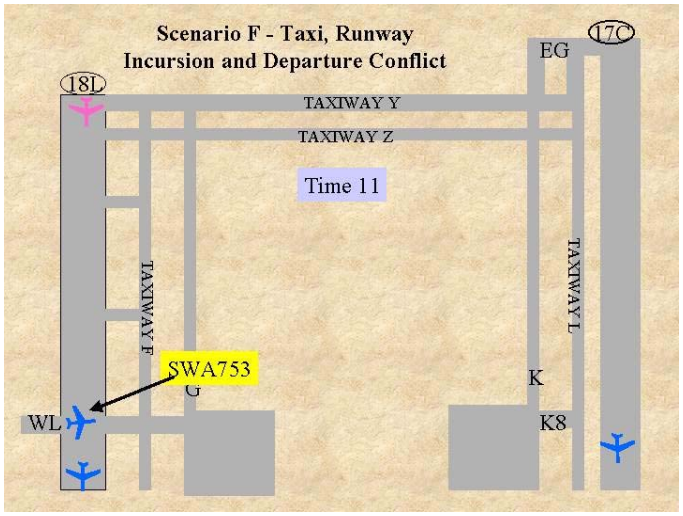

Scenario F - Taxi, Runway
Incursion and Departure Conflict
18L
TAXIWAY Y
TAXIWAY Z
TIME 6
TAXIWAY F
TAXIWAY L
G
K
K8

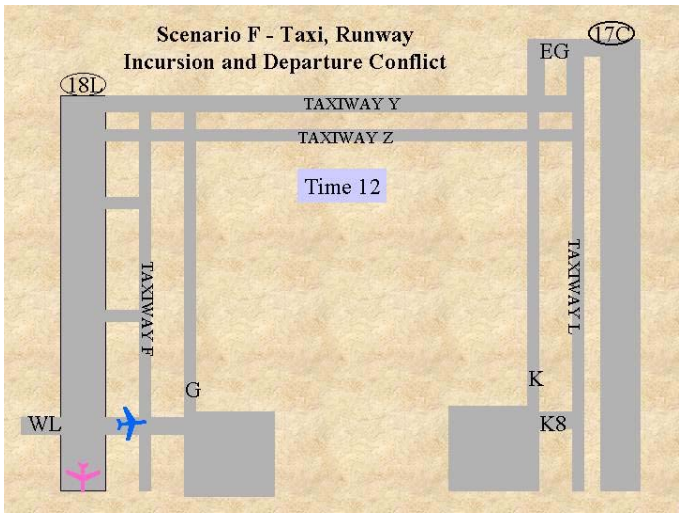

Scenario F - Taxi, Runway
Incursion and Departure Conflict
18L
TAXIWAY Y
TAXIWAY Z
TIME 7
TAXIWAY F
TAXIWAY L
G
K
K8

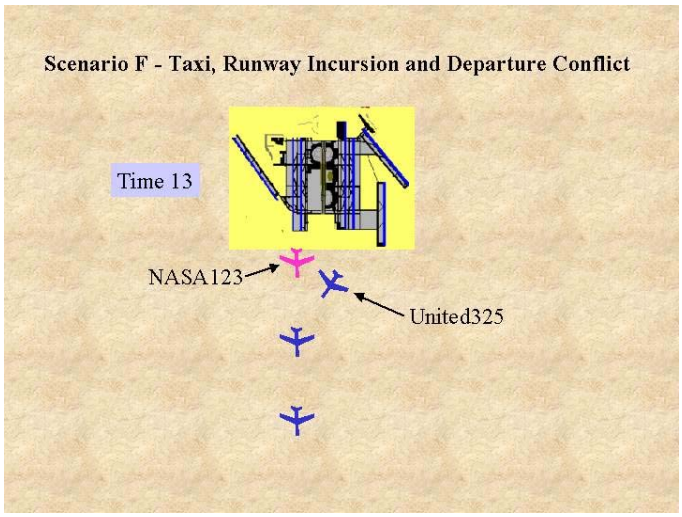

Scenario F - Taxi, Runway
Incursion and Departure Conflict
17C
EG
18L
TAXIWAY Y
TAXIWAY Z
Time 8
TAXIWAY F
TAXIWAY L
G
K
WL
K8

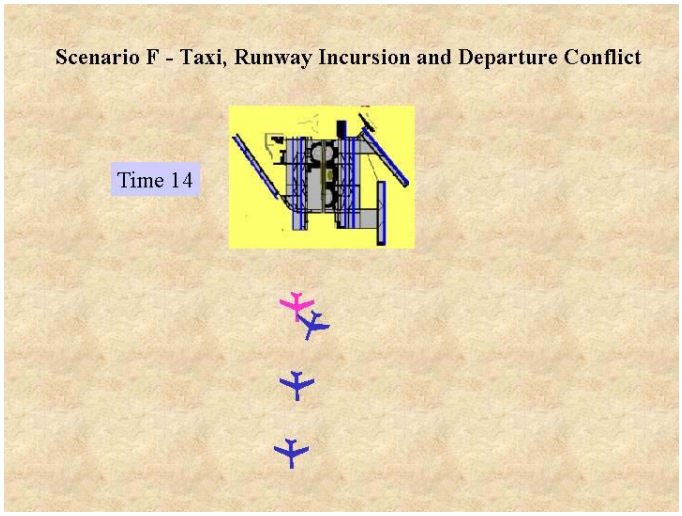

Scenario F - Taxi, Runway
Incursion and Departure Conflict
18L
17C
EG
TAXIWAY Y
TAXIWAY Z
Time 9
TAXIWAY F
TAXIWAY L
G
K
WL
K8


Scenario F - Taxi, Runway
Incursion and Departure Conflict
18L
17C
EG
TAXIWAY Y
TAXIWAY Z
Time 10
TAXIWAY F
TAXIWAY L
SWA753
G
K
WL
K8


Scenario F - Taxi, Runway
Incursion and Departure Conflict
18L
17C
EG
TAXIWAY Y
TAXIWAY Z
Time 11
TAXIWAY F
TAXIWAY L
SWA753
G
K
WL
K8

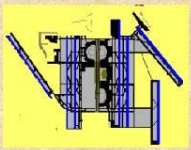

Scenario F - Taxi, Runway
Incursion and Departure Conflict
18L
17C
EG
TAXIWAY Y
TAXIWAY Z
Time 12
TAXIWAY F
TAXIWAY L
G
K
WL
K8


Scenario F - Taxi, Runway Incursion and Departure Conflict
Time 13
NASA123
United325


Scenario F - Taxi, Runway Incursion and Departure Conflict
Time 14

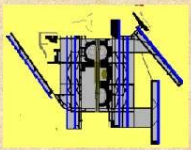
Scenario F - Taxi, Runway Incursion and Departure Conflict

Time 15



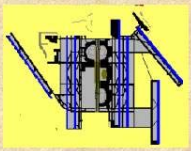
Scenario F - Taxi, Runway Incursion and Departure Conflict

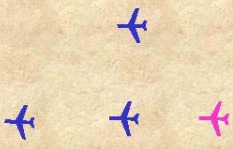
Time 16



Scenario F - Taxi, Runway Incursion and Departure Conflict

Time 17





Amer228

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	K8	603	090	0	15	D	175	0
1	Taxiway L	603	360	20	15	D	175	0
2	Taxiway L	603	360	20	15	D	175	0
3	Taxiway L	603	360	20	15	D	175	0
4	Taxiway Z	603	270	20	15	D	175	0
5	Taxiway Z	603	270	20	15	D	175	0
6	Taxiway Z	603	270	20	15	D	175	0
7	Taxiway F	603	360	20	15	D	175	0
8	Taxiway Y	603	270	20	15	D	175	0
9	Rwy 18L	603	180	0	15	D	175	0
10	Rwy 18L	603	180	180	15	D	175	0
11	Heading 185	1000	185	220	15	U	175	0
12	Heading 185	3500	185	250	5	U	175	0
13	Heading 185	6000	185	250	U	U	175	0
14	Heading 185	8500	185	250	U	U	175	0
15	Heading 270	10000	270	250	U	U	175	0
16	Heading 270	10000	270	250	U	U	175	0
17	Heading 270	10000	270	250	U	U	175	0
18								
19								
20								

Time	Radio Traffic - Initial Call "Amer228, Kilo8, Information B to taxi"
0	Amer228, DFW gnd - taxi to Rwy 18L via Lima, Zulu, Foxtrot. Contact West Gnd on the Bridge
1	
2	
3	
4	
5	Amer228, DFW Gnd - Hold short of runway 18L on Yankee
6	
7	Amer228, contact twr
8	Amer228, taxi into position Rwy 18L and hold
9	Amer228, cleared for takeoff
10	
11	
12	Amer228, contact departure control
13	Amer228, DFW departure, maintain 10000ft
14	Amer228, turn right heading 270
15	
16	
17	
18	
19	
20	
21	

NWA987

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
1	G11	603	270	0	15	D	175	0
2	Taxiway F	603	360	10	15	D	175	0
3	Taxiway F	603	360	10	15	D	175	0
4	Taxiway F	603	360	10	15	D	175	0
5	Taxiway F	603	360	10	15	D	175	0
6	Taxiway F	603	360	10	15	D	175	0
7	Taxiway F	603	360	10	15	D	175	0
8	Taxiway F	603	360	10	15	D	175	0
9	Taxiway Y	603	270	10	15	D	175	0
10	Rwy 18L	603	180	0	15	D	175	0
11	Rwy 18L	603	180	180	15	D	175	0
12	Heading 185	1000	185	220	15	U	175	0
13	Heading 185	3500	185	250	5	U	175	0
14	Heading 185	6000	185	250	U	U	175	0
15	Heading 185	8500	185	250	U	U	175	0
16	Heading 270	10000	270	250	U	U	175	0
17	Heading 270	10000	270	250	U	U	175	0
18	Heading 270	10000	270	250	U	U	175	0
19								
20								
21								

Time	Radio Traffic - Initial Call "United 98, information B, G11, taxi"
1	NWA987, DFW gnd - taxi to Rwy 18L via Foxtrot, Yankee
2	
3	
4	
5	
6	NWA987, Follow the American 757 on Zulu
7	
8	NWA987, contact twr
9	NWA987, taxi into position Rwy 18L and hold
10	NWA987, cleared for takeoff
11	
12	
13	NWA987, contact departure control
14	NWA987, DFW departure, maintain 10000ft
15	NWA987, turn right heading 270
16	
17	
18	
19	
20	
21	

NASA123

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
2	K8	603	090	0	15	D	175	0
3	Taxiway L	603	360	20	15	D	175	0
4	Taxiway L	603	360	20	15	D	175	0
5	Taxiway L	603	360	20	15	D	175	0
6	Taxiway Z	603	270	20	15	D	175	0
7	Taxiway Z	603	270	20	15	D	175	0
8	Taxiway Z	603	270	20	15	D	175	0
9	Taxiway F	603	360	20	15	D	175	0
10	Taxiway Y	603	270	20	15	D	175	0
11	Rwy 18L	603	180	0	15	D	175	0
12	Rwy 18L	603	180	180	15	D	175	0
13	Heading 185	1000	185	220	15	U	175	0
14	Heading 185	3500	185	250	5	U	175	0
15	Heading 185	6000	185	250	U	U	175	0
16	Heading 185	8500	185	250	U	U	175	0
17	Heading 270	10000	270	250	U	U	175	0
18	Heading 270	10000	270	250	U	U	175	0
19	Heading 270	10000	270	250	U	U	175	0
20								
21								
22								

Time	Radio Traffic - Initial Call "NASA123, information B, K8, taxi"
2	NASA123, DFW gnd - taxi to Rwy 18L via Lima, Zulu, Foxtrot. Contact West Gnd on the Bridge
3	
4	
5	
6	
7	NASA123, DFW Gnd - Follow the United 737 on Foxtrot to 18L
8	
9	NASA123, contact twr
10	NASA123, taxi into position Rwy 18L and hold
11	NASA123, cleared for takeoff
12	
13	
14	NASA123, contact departure control
15	NASA123, DFW departure, maintain 10000ft
16	NASA123, turn right heading 270
17	
18	
19	
20	
21	

United325

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
3	K8	603	090	0	15	D	175	0
4	Taxiway K	603	360	10	15	D	175	0
5	Taxiway K	603	360	10	15	D	175	0
6	Taxiway K	603	360	10	15	D	175	0
7	Taxiway K	603	360	10	15	D	175	0
8	Taxiway K	603	360	10	15	D	175	0
9	Taxiway EG	603	090	10	15	D	175	0
10	Rwy 17R	603	180	0	15	D	175	0
11	Rwy 17R	603	180	180	15	D	175	0
12	Heading 200	1000	200	200	15	U	175	0
13	Heading 200	3500	200	210	5	U	175	0
14	Heading 200	3500	200	210	U	U	175	0
15	Heading 200	3500	200	210	U	U	175	0
16	Heading 270	3500	200	210	U	U	175	0
17	Heading 270	3500	200	210	U	U	175	0
18	Heading 270	3500	200	210	U	U	175	0
19								
20								
21								
22								
23								

Time	Radio Traffic - Initial Call "United325, G11, information B, taxi"
3	United325, DFW gnd - taxi to Rwy 17C via Kilo, EchoGolf
4	
5	
6	
7	
8	United325, contact twr
9	United325, taxi into position Rwy 17C and hold
10	United325, cleared for takeoff
11	
12	
13	United325, contact departure control
14	
15	
16	
17	
18	
19	
20	
21	

SWA753

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	DL	3000	120	230	0	U	175	0
1	DL	3000	120	230	0	U	175	0
2	DL	3000	120	210	5	U	175	0
3	YOHAN	3000	180	210	5	U	175	0
4		3000	180	210	5	U	175	0
5	LEGRE	3000	180	195	5	U	175	0
6	HASTY	2400	180	180	15	D	175	0
7			180	150	30	D	175	0
8			180	130	30	D	175	0
9	touchdown	603	180	130	30	D	175	0
10	on WL	603	090	10	30	D	175	0
11	on 18L	603	090	0	30	D	175	0
12	WL	603	090	10	30	D	175	0
13	G	603	360	10	30	D	175	0
14								
15								
16								
17								
18								
19								
20								

Time	Radio Traffic
0	
1	
2	SWA753 - turn rt hdg 175, maintain 180 kts to the marker,
3	SWA753 cleared for the ILS app rwy 18R, tower now on 124.15
4	
5	
6	SWA753, cleared to land
7	
8	
9	
10	SWA753, hold short runway 18L,
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

ATC Master Communication Log- Scenario F

Air Traffic Controller Radio Communications

Scripted Radio Calls from Other Aircraft

NASA 123 Radio Suggested Radio Calls

Time 0

Initial Call "Amer228, Kilo8, Information B to taxi"
Amer228, DFW gnd - taxi to Rwy 18L via Lima, Zulu, Foxtrot. Contact West Gnd on the Bridge
(Reply)

Time 1

Time 2

Initial Call "NASA123, information B, K8, taxi"
NASA123, DFW gnd - taxi to Rwy 18L via Lima, Zulu, Foxtrot. Contact West Gnd on the Bridge
(Reply)

Time 3

Initial Call “United 325, information B, K8, taxi”
United325, DFW gnd – taxi to Rwy 17R

Time 4

Time 5

Time 6

Time 7

DFW ground, NASA123 on the bridge for runway 18L
NASA123, DFW Gnd - Follow the Northwest 737 on Foxtrot to 18L
(Reply)
Amer228, contact twr
(Reply)

Time 8

NWA987, contact twr
(Reply)
United325, DFW Gnd - follow the NASA 757 on Z to 18L
(Reply)

Time 9

NASA123, contact twr

(Reply)

Time 10

NWA987, cleared for takeoff
(Reply)
NASA123, taxi into position Rwy 18L and hold
(Reply)
Southwest753, hold short of runway 18L
(Reply)

Time 11

NASA123, cleared for takeoff
(Reply)
United325, taxi into position Rwy 18L and hold
(Reply)

Time 12

Amer228, contact departure control
(Reply)
United325, cleared for takeoff
(Reply)

Time 13

NWA987, contact departure control
(Reply)

Time 14

NASA123, contact departure control
(Reply)

Time 15

NWA987, turn right heading 270
(Reply)
NASA123, DFW departure, maintain 10000ft
(Reply)

Time 16

NASA123, turn right heading 270
(Reply)
United325, DFW departure, maintain 10000ft
(Reply)

Time 17

United325, turn right heading 270
(Reply)

Line Oriented Evaluation Scenario G

Flight into Terrain during Arrival Vectoring

SVS Aspects Tested: The following CaB SVS CONOPS applications are tested in this scenario.

Approach

- A-5 Terrain Avoidance Equivalent to VMC

Time: 12 minutes

The weather conditions in this scenario are visibility to be less than a three miles. It could also take place at night.

This scenario tests the ability of the subject to develop and maintain general situation awareness of dangerously high terrain during a normal arrival. The test subject aircraft (NASA 123) begins the scenario level at FL350 over the Peach Springs VOR southeast of Las Vegas. NASA 123 is cleared for the Peach Springs arrival, to cross BUMMR intersection at 10,000 feet. NASA 123 is told to expect vectors for the ILS approach to runway 25L. Once level at 10,000 feet at BUMMR, Los Angles Center directs NASA 123 to contact Las Vegas Approach. Las Vegas Approach mistakes NASA 123 for another aircraft on a different frequency northeast of the field and clears it direct to the LAS VOR, with a decent to 5000 feet. Approximately half way between BUMMR and the VOR at the airfield is a mountain ridge with a peak 5445 feet high. If NASA 123 follows this clearance it will impact the terrain.

SA Measurement

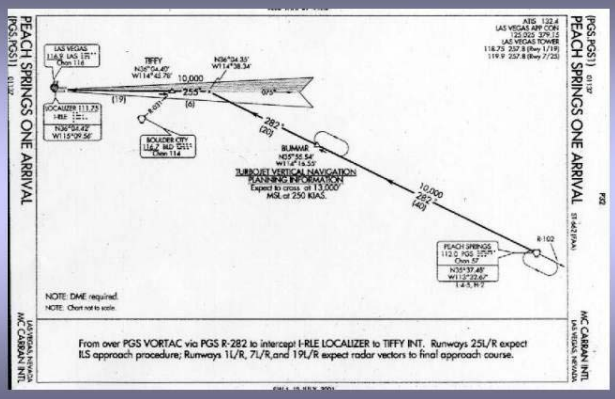
(1) Time to respond to the terrain on flight path should be calculated beginning with the time at which the aircraft is turned towards it. Pilot response may vary to include deviation off the flight path, changing altitude, making an ATC call for a new flight path, or making a verbal comment.

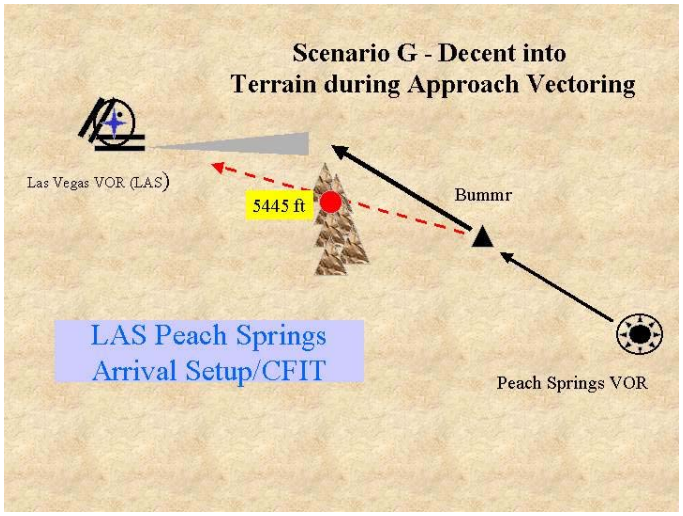
(2) SAGAT – The SA of the pilot should be measured via SAGAT queries at 2 different freeze points (at times 4.27, 10.50). Queries should include:

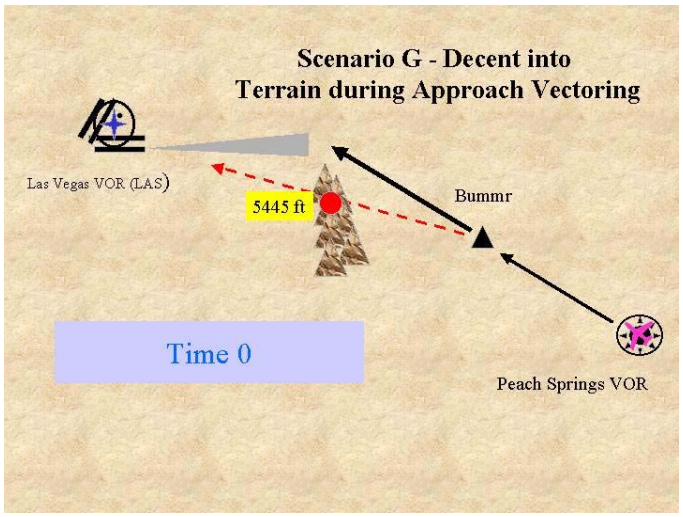
- Query 1 What is the current heading of your aircraft?
- Query 2 What is the current altitude (MSL) of your aircraft?
- Query 3 What is the indicated airspeed of your aircraft?
- Query 4 What is the current rate of climb/descent of your aircraft?
- Query 5 What is the attitude of your aircraft (pitch and bank)?
- Query 6 What are your current settings (flaps, slats, gear, speed brakes)?
- Query 7 How much fuel do you currently have?
- Query 8 What are the current winds (direction, magnitude, gusting to)?
- Query 14 Are you in conformance with your current clearance for this phase of flight?
- Query 15 Is there any conflicting traffic on your current (projected) flight path?
- Query 16 Conflicting traffic is currently located at (bearing and miles)?
- Query 17 Traffic Conflict Type
- Query 18 Is a change in path or altitude needed to avoid obstacles or terrain?
- Query 20 Is there any hazardous weather along your route in this phase of flight?
- Query 21 What impact is the hazardous weather having on your flight?
- Query 24 Are your systems correctly set-up for this phase of flight?
- Query 25 What is your current altimeter setting?
- Query 30 How far to the destination airport along your planned route of flight?
- Query 32 How far to your next waypoint?

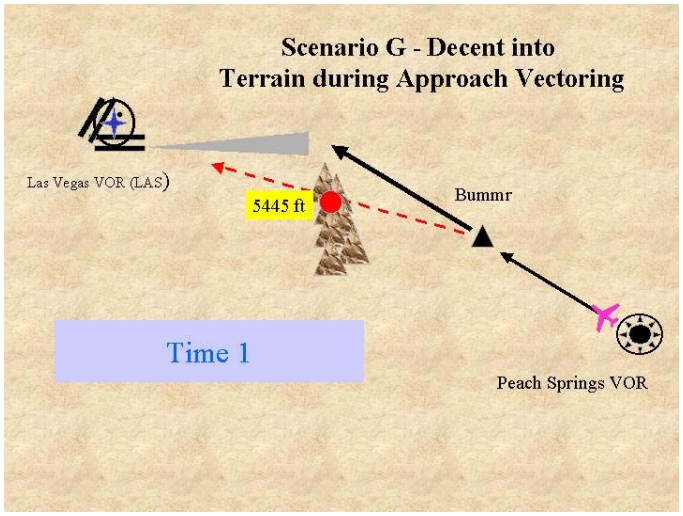
Scenarios for Assessing the Utility of Synthetic Visual Systems (SVS) in Commercial and Business (CaB) Aircraft

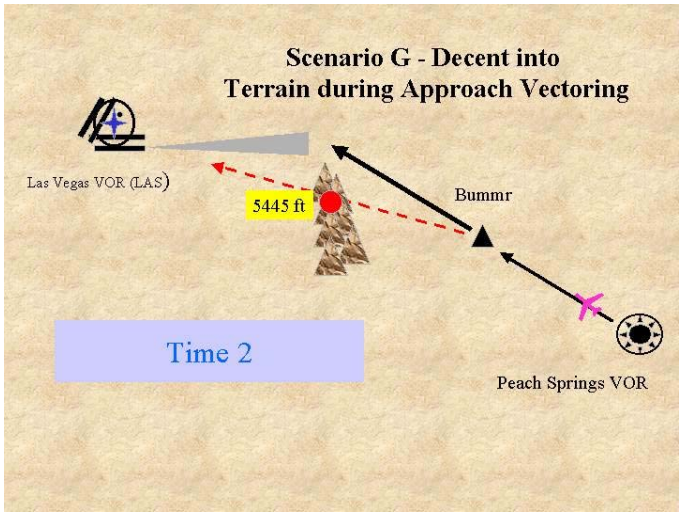
Scenario G - Decent into Terrain during Approach Vectoring Las Vegas, NV

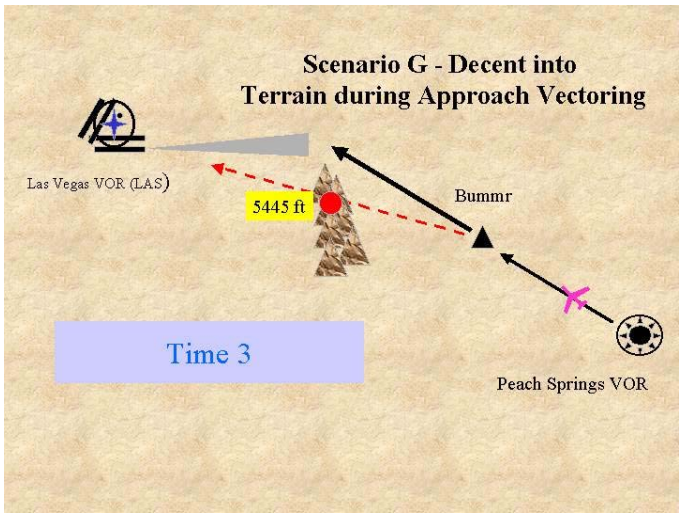


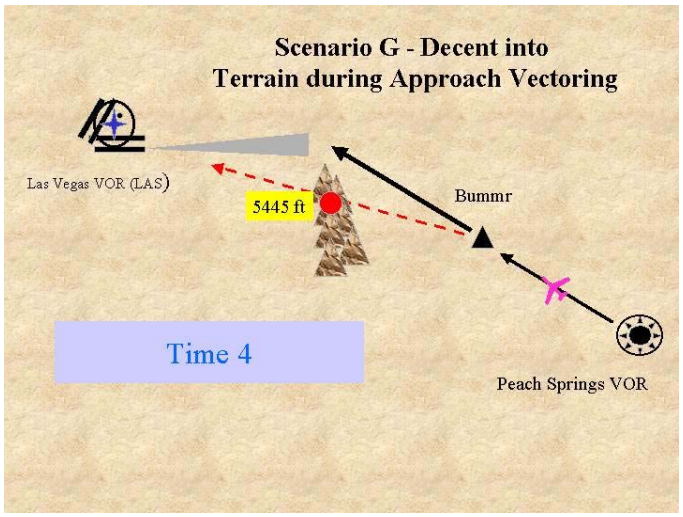


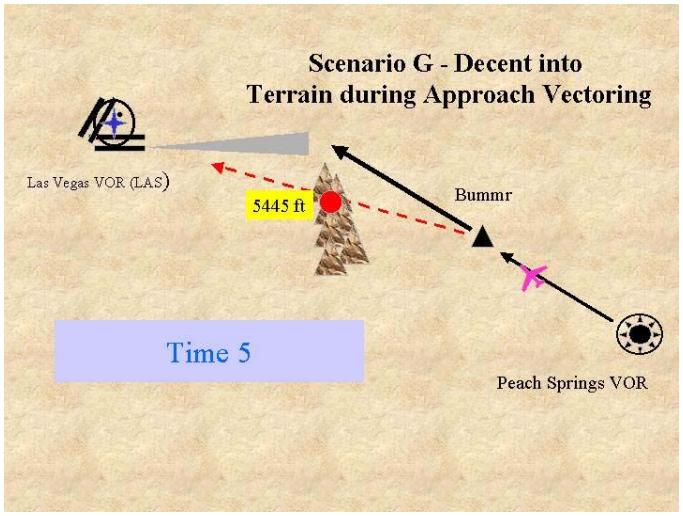

Scenario G - Decent into
Terrain during Approach Vectoring
Las Vegas VOR (LAS)
5445 ft
Bummr
Time 0
Peach Springs VOR

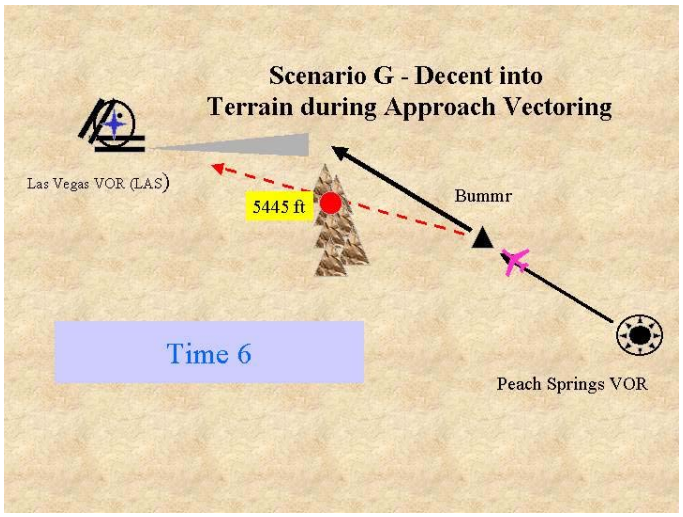

Scenario G - Decent into
Terrain during Approach Vectoring
Las Vegas VOR (LAS)
5445 ft
Bummr
Time 1
Peach Springs VOR

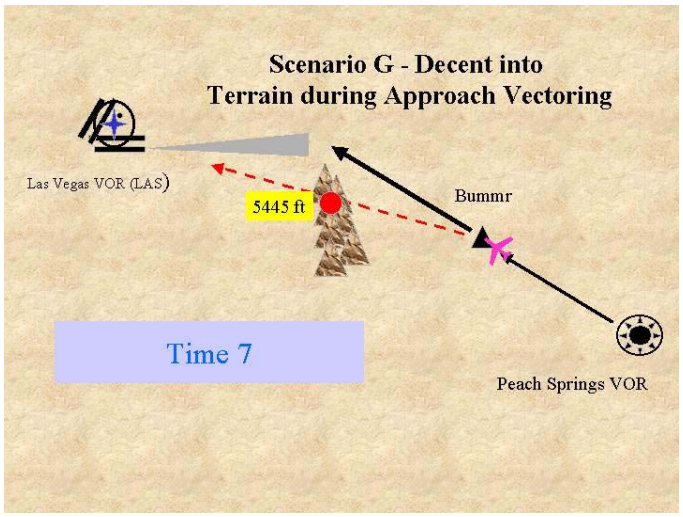

Scenario G - Decent into
Terrain during Approach Vectoring
Las Vegas VOR (LAS)
5445 ft
Bummr
Time 2
Peach Springs VOR

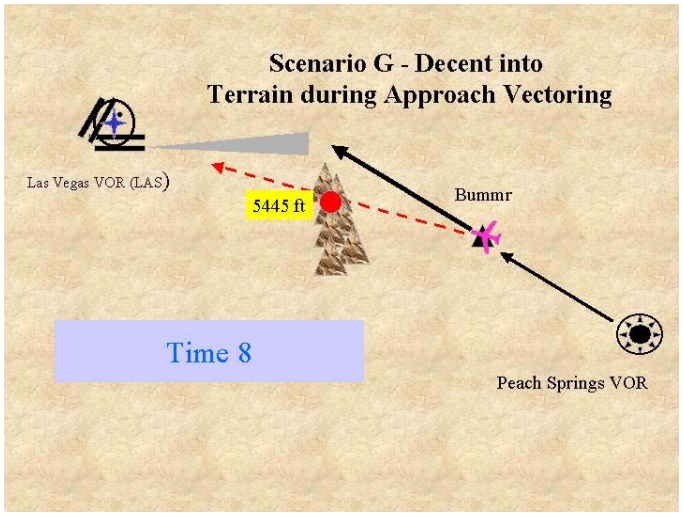

Scenario G - Decent into
Terrain during Approach Vectoring
Las Vegas VOR (LAS)
5445 ft
Bummr
Time 3
Peach Springs VOR

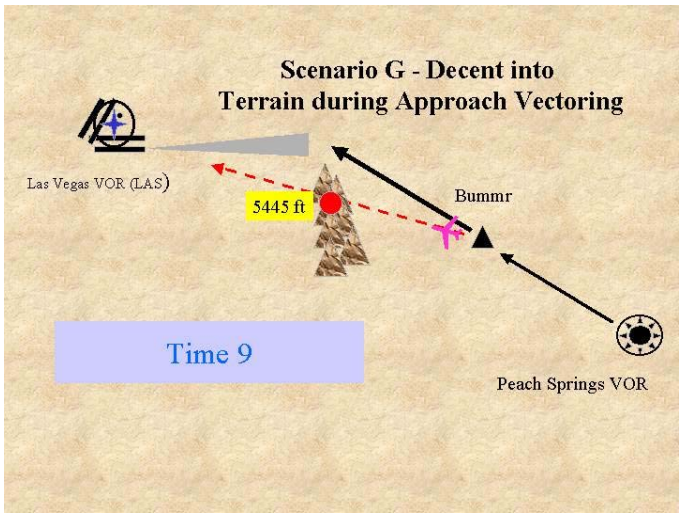

Scenario G - Decent into
Terrain during Approach Vectoring
Las Vegas VOR (LAS)
5445 ft
Bummr
Time 4
Peach Springs VOR

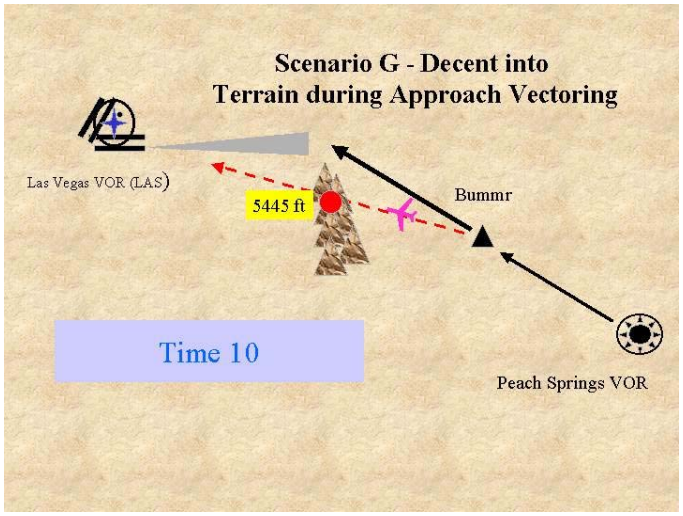

Scenario G - Decent into
Terrain during Approach Vectoring
Las Vegas VOR (LAS)
5445 ft
Bummr
Time 5
Peach Springs VOR

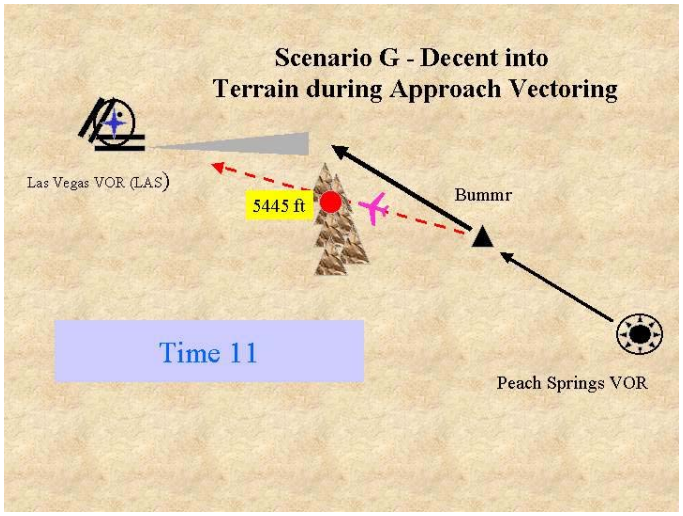

Scenario G - Decent into
Terrain during Approach Vectoring
Las Vegas VOR (LAS)
5445 ft
Bummr
Time 6
Peach Springs VOR

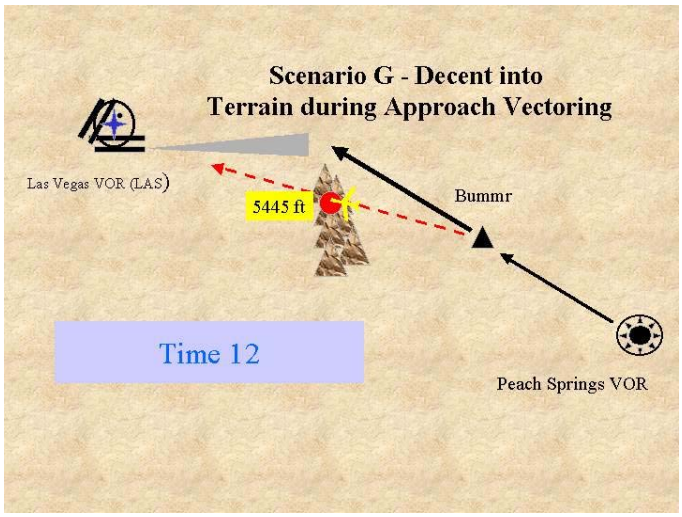

Scenario G - Decent into
Terrain during Approach Vectoring
Las Vegas VOR (LAS)
5445 ft
Bummr
Time 7
Peach Springs VOR


Scenario G - Decent into
Terrain during Approach Vectoring
Las Vegas VOR (LAS)
5445 ft
Bummr
Time 8
Peach Springs VOR


Scenario G - Decent into
Terrain during Approach Vectoring
Las Vegas VOR (LAS)
5445 ft
Bummr
Time 9
Peach Springs VOR


Scenario G - Decent into
Terrain during Approach Vectoring
Las Vegas VOR (LAS)
5445 ft
Bummr
Time 10
Peach Springs VOR


Scenario G - Decent into
Terrain during Approach Vectoring
Las Vegas VOR (LAS)
5445 ft
Bummr
Time 11
Peach Springs VOR


Scenario G - Decent into
Terrain during Approach Vectoring
Las Vegas VOR (LAS)
5445 ft
Bummr
Time 12
Peach Springs VOR

Scenario G – Aircraft Data

NASA123

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	PGS VOR	24000	282	300	U	U	0	0
1	PGS+5	22000	282	300	U	U	0	0
2	PGS+10	20000	282	300	U	U	0	0
3	PGS+15	18000	282	300	U	U	0	0
4	PGS+20	16000	282	300	U	U	0	0
5	PGS+25	14000	282	300	U	U	0	0
6	PGS+30	12000	282	300	U	U	0	0
7	PGS+35	11000	282	280	U	U	0	0
8	Bummr	10000	270	250	U	U	0	0
9	Bummr+4	9000	270	240	U	U	0	0
10	Bummr+8	7500	270	240	U	U	0	0
11	Bummr+12	6000	270	240	U	U	0	0
12	Mountain	5000	270	240	U	U	0	0

Time	Radio Traffic
0	NASA123, Cross Bummr at 10000 ft, 250 knots
1	NASA123, report information A, expect vector for ILS approach rwy 25L
2	
3	
4	
5	
6	
7	
8	NASA123, contact Vegas approach, 125.05
9	NASA123, turn left hdg 270, proceed direct to the LAS VOR, decend and maintain 5000 ft.
10	NASA123, information B current, expect vectors for a visual approach Rwy 19L
11	NASA123, squawk ident
12	

ATC Master Communication Log- Scenario G

Air Traffic Controller Radio Communications

NASA 123 Radio Suggested Radio Calls

Time 0

Los Angles Center, NASA 123 checking in at flight level 350
NASA123, decent now, cross Bummr at 10000 ft, 250 knots
(reply)

Time 1

NASA123 expect vectors for ILS approach rwy 25L
(reply)

Time 2

Time 3

Time 4

Time 5

Time 6

Time 7

Time 8

NASA123, contact Vegas approach, 125.05
(reply)

Time 9

Las Vegas Approach, NASA 123 checking in
NASA123, information B current, expect vectors for a visual approach Rwy 19L. Turn left hdg 270, proceed direct to the LAS VOR, decend and maintain 5000 ft.
(reply)

Time 10

Time 11

NASA123, squawk ident

Time 12

Line Oriented Evaluation Scenario H

Flight into Terrain during Departure Vectoring

SVS Aspects Tested: The following CaB SVS CONOPS applications are tested in this scenario.

Departure

- A-5 Terrain Avoidance Equivalent to VMC

Time: 15 minutes

The weather conditions in this scenario are visibility to be less than a three miles. It could also take place at night.

This scenario tests the ability of the subject to develop and maintain general situation awareness of dangerously high terrain during a normal departure. The test subjects aircraft (NASA 123) begins the scenario at the departure end of runway 19L at KLAS. NASA 123 is clear to destination airport via Meads departure, BLD, Goffs VOR, on course. On initial contact with Las Vegas Departure NASA 123 is cleared direct to BLD VOR to maintain 7000 feet for traffic separation. The departure controller then gives NASA 123 a revised enroute clearance to proceed direct to CRESO intersection than via V538 to Goffs VOR. He fails to give NASA 123 a climb to a safe altitude for the route. Approximately 20 miles south of CRESO is a mountain peak 7026 feet high. If NASA 123 remains at 7000 feet it will impact this terrain.

SA Measurement

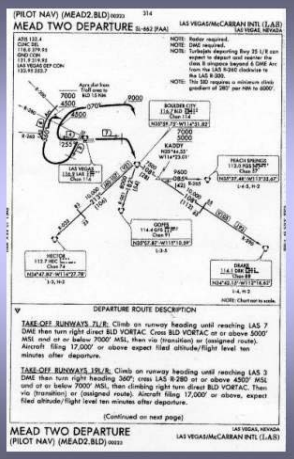
(1) Time to respond to the terrain on flight path should be calculated beginning with the time at which the aircraft is turned towards it. Pilot response may vary to include deviation off the flight path, changing altitude, making an ATC call for a new flight path, or making a verbal comment.

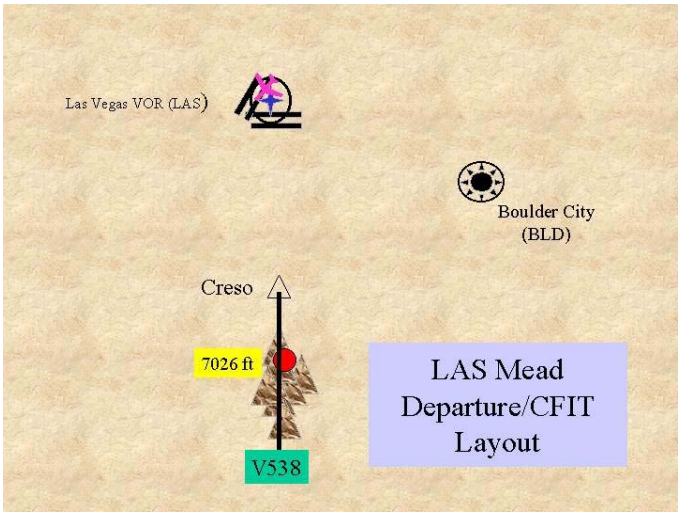
(2) SAGAT – The SA of the pilot should be measured via SAGAT queries at 3 different freeze points (at times 5.47, 9.52, 12.57). Queries should include:

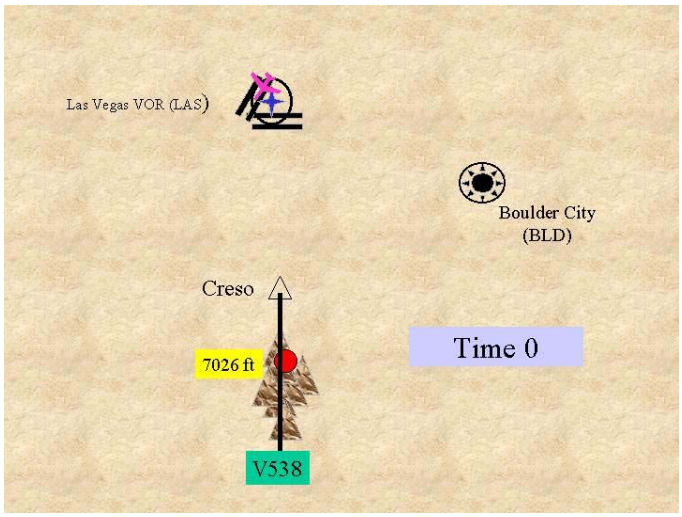
- Query 1 What is the current heading of your aircraft?
- Query 2 What is the current altitude (MSL) of your aircraft?
- Query 3 What is the indicated airspeed of your aircraft?
- Query 4 What is the current rate of climb/descent of your aircraft?
- Query 5 What is the attitude of your aircraft (pitch and bank)?
- Query 6 What are your current settings (flaps, slats, gear, speed brakes)?
- Query 7 How much fuel do you currently have?
- Query 8 What are the current winds (direction, magnitude, gusting to)?
- Query 14 Are you in conformance with your current clearance for this phase of flight?
- Query 15 Is there any conflicting traffic on your current (projected) flight path?
- Query 16 Conflicting traffic is currently located at (bearing and miles)?
- Query 17 Traffic Conflict Type
- Query 18 Is a change in path or altitude needed to avoid obstacles or terrain?
- Query 20 Is there any hazardous weather along your route in this phase of flight?
- Query 21 What impact is the hazardous weather having on your flight?
- Query 24 Are your systems correctly set-up for this phase of flight?
- Query 25 What is your current altimeter setting?
- Query 30 How far to the destination airport along your planned route of flight?
- Query 32 How far to your next waypoint?

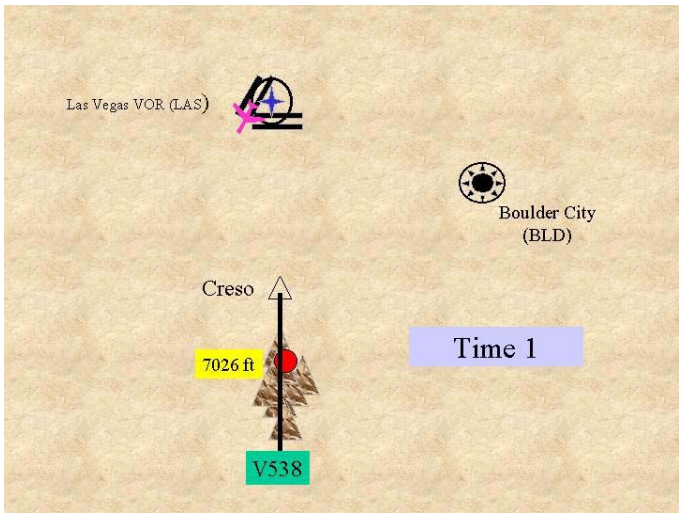
Scenarios for Assessing the Utility of Synthetic Visual Systems (SVS) in Commercial and Business (CaB) Aircraft

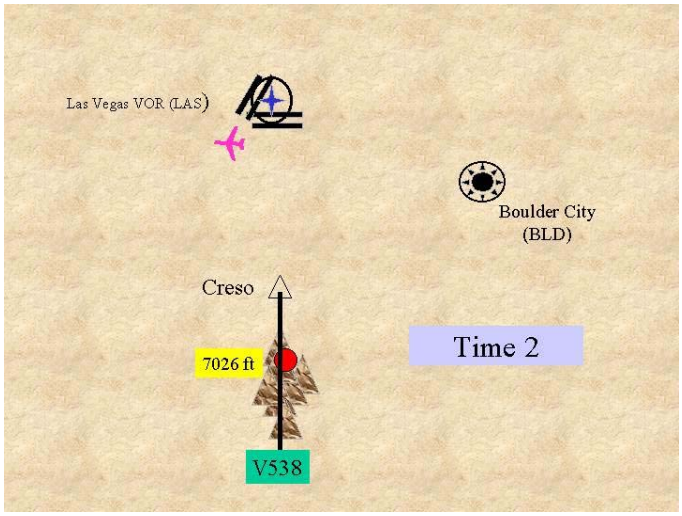
Scenario H - Flight into Terrain during Departure Vectoring Las Vegas, NV

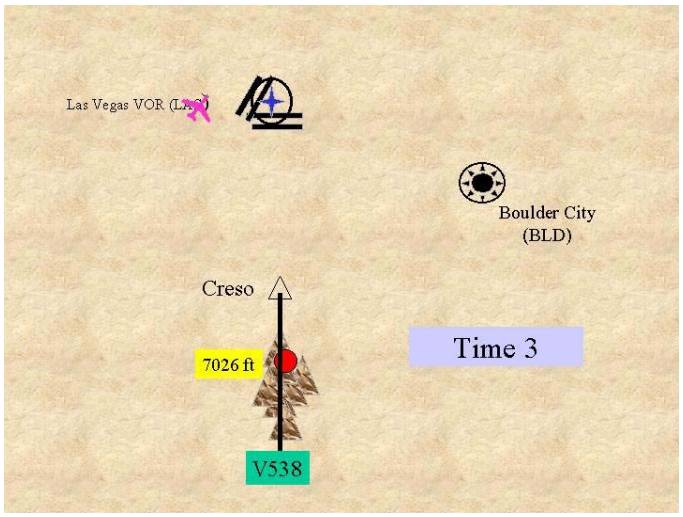


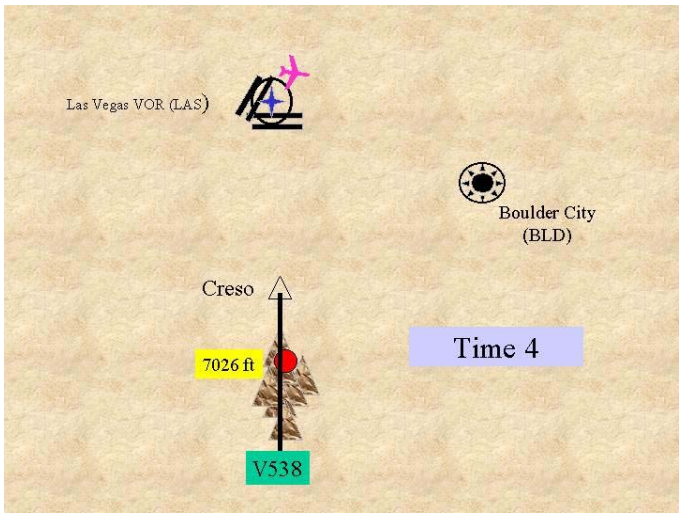


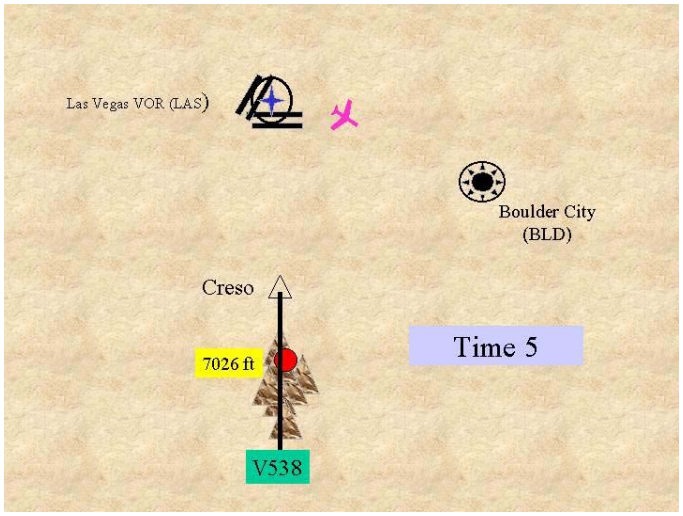

Las Vegas VOR (LAS)
Boulder City
(BLD)
Creso
7026 ft
V538
Time 0

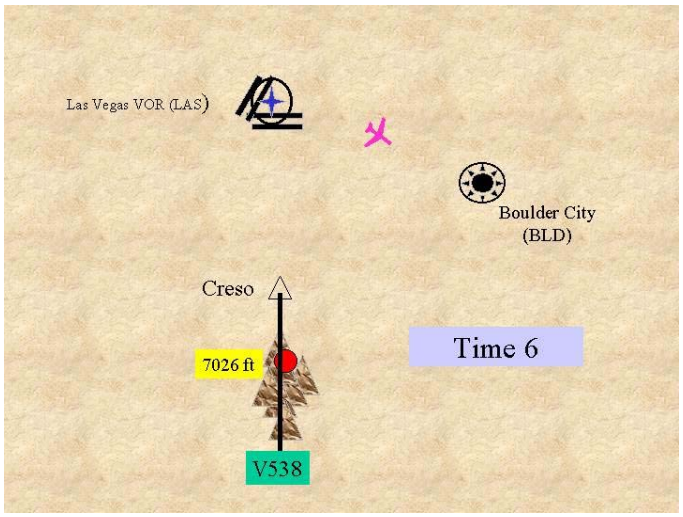

Las Vegas VOR (LAS)
Boulder City
(BLD)
Creso
7026 ft
V538
Time 1

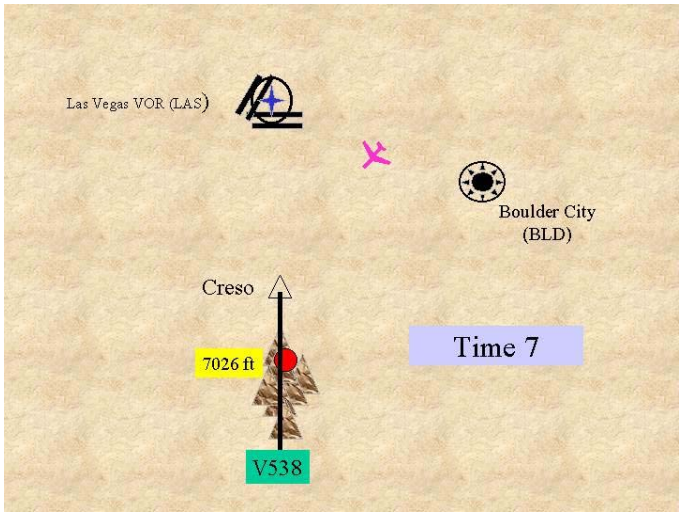

Las Vegas VOR (LAS)
Boulder City
(BLD)
Creso
7026 ft
V538
Time 2

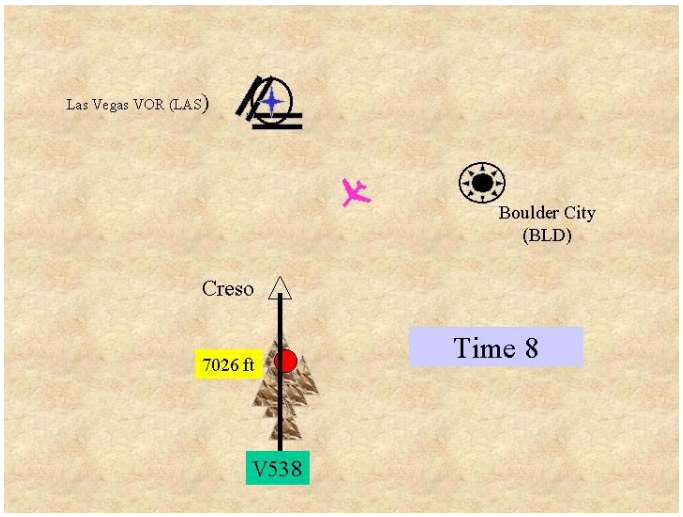

Las Vegas VOR (LAS)
Boulder City
(BLD)
Creso
7026 ft
V538
Time 3

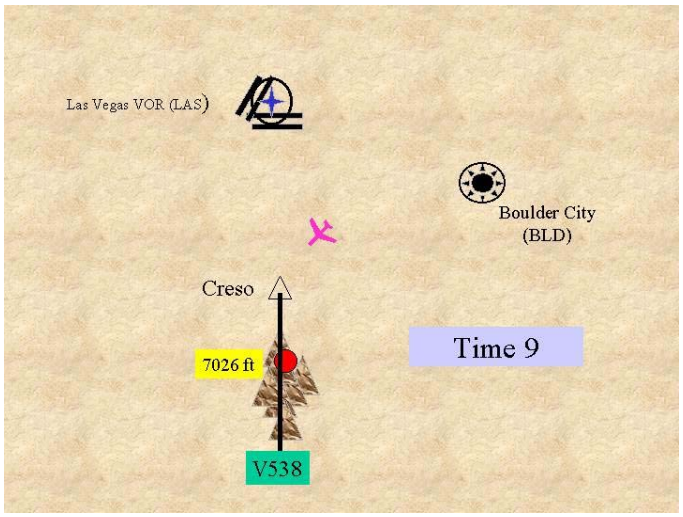

Las Vegas VOR (LAS)
Boulder City
(BLD)
Creso
7026 ft
V538
Time 4

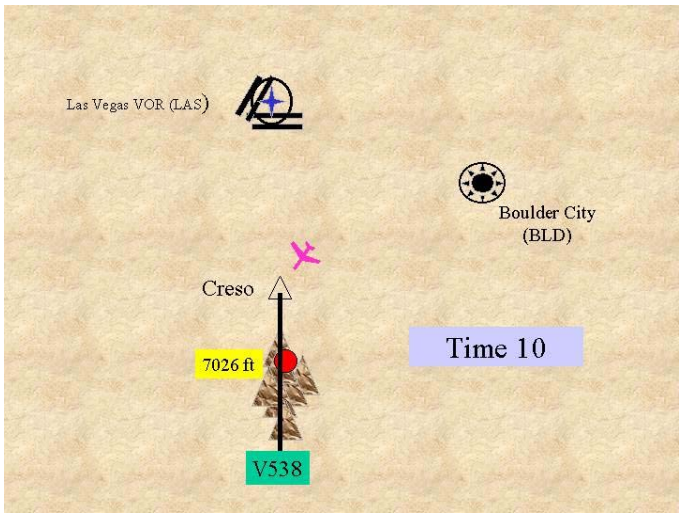

Las Vegas VOR (LAS)
Boulder City
(BLD)
Creso
7026 ft
V538
Time 5

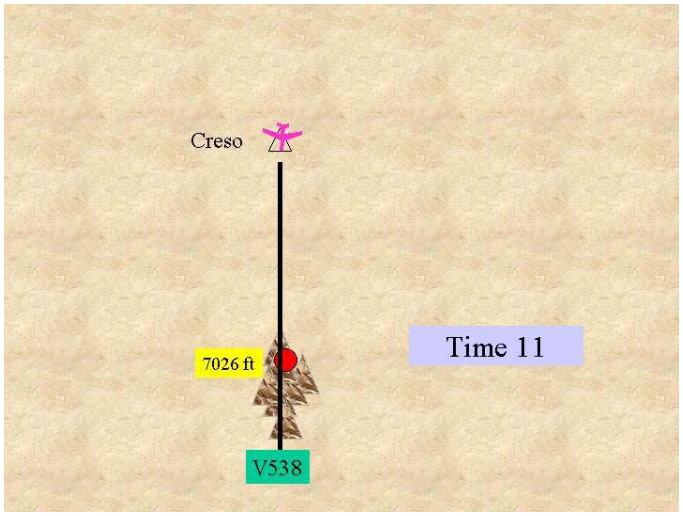

Las Vegas VOR (LAS)
Boulder City
(BLD)
Creso
7026 ft
V538
Time 6

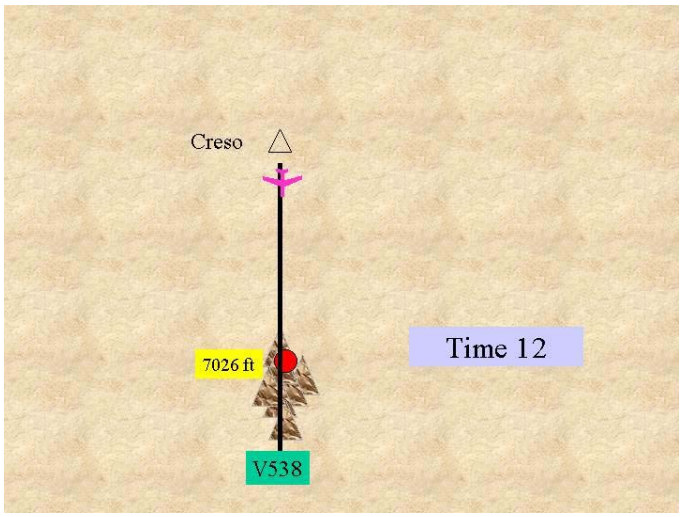

Las Vegas VOR (LAS)
Boulder City
(BLD)
Creso
7026 ft
V538
Time 7

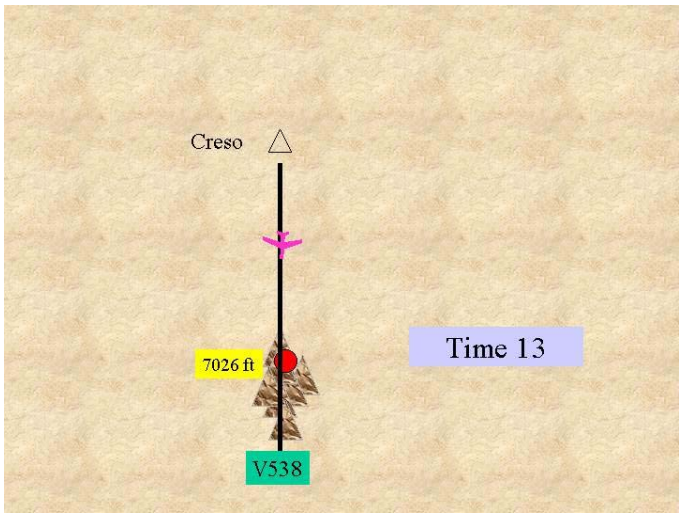

Las Vegas VOR (LAS)
Boulder City
(BLD)
Creso
7026 ft
V538
Time 8

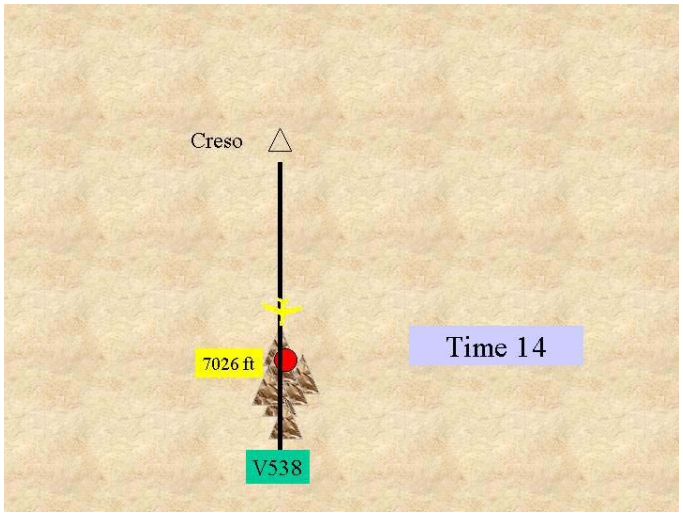

Las Vegas VOR (LAS)
Boulder City
(BLD)
Creso
7026 ft
V538
Time 9

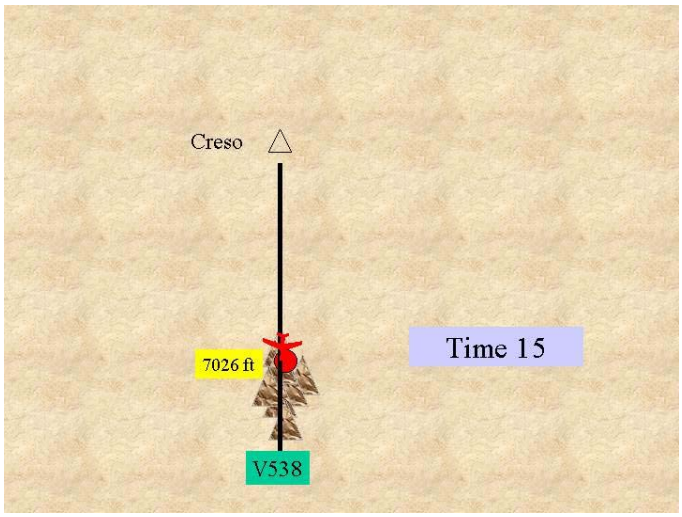

Las Vegas VOR (LAS)
Boulder City
(BLD)
Creso
7026 ft
V538
Time 10


Creso
7026 ft
V538
Time 11


Creso
7026 ft
V538
Time 12


Creso
7026 ft
V538
Time 13


Creso
7026 ft
V538
Time 14


Creso
7026 ft
Time 15
V538

Scenario H – Aircraft Data

NASA123

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	T/O Rwy 19L	2181	190	0	D	15	0	0
1	Dpt end 19L	3000	190	180	D	15	0	0
2	3 DME	4500	270	210	U	5	0	0
3	Hdg 360	6000	360	250	U	U	0	0
4	Hdg 070	7000	070	250	U	U	0	0
5	Hdg 100	7000	100	250	U	U	0	0
6	Hdg 100	7000	100	250	U	U	0	0
7	Direct Creso	7000	200	250	U	U	30	30
8	Direct Creso	7000	270	250	U	U	0	0
9	Direct Creso	7000	270	240	U	U	0	0
10	Direct Creso	7000	270	240	U	U	0	0
11	Creso	7000	180	240	U	U	0	0
12	V538	7000	180	240	U	U	0	0
13	V538	7000	180	240	U	U	0	0
14	V538	7000	180	240	U	U	0	0
15	Mountain	7000	180	240	U	U	0	0

Time	Radio Traffic
0	NASA123, Cleared for takeoff
1	
2	
3	NASA123, contact Vegas departure 125.05
4	NASA123, maintain 7000
5	
6	NASA123, turn right direct Creso, cleared to destination via Creso, V538, Goffs
7	
8	
9	
10	
11	
12	
13	
14	NASA123, squawk ident

ATC Master Communication Log- Scenario H

Air Traffic Controller Radio Communications

NASA 123 Radio Suggested Radio Calls

Time 0

NASA123, Cleared for takeoff

Time 1

Time 2

Time 3

NASA123, contact Vegas departure 125.05

Time 4

NASA123, maintain 7000

Time 5

Time 6

NASA123, turn right direct Creso, cleared to destination via Creso, V538, Goffs

Time 7

Time 8

Time 9

Time 10

Time 11

Time 12

Time 13

Time 14

NASA123, squawk ident

Line Oriented Evaluation Scenario I

GA Traffic Pattern Entry and Landing in Challenging Terrain – Eagle Vail

SVS Aspects Tested: The following GA SVS CONOPS applications are tested in this scenario.

Approach

- A-5 Terrain Avoidance Equivalent to VMC
- A-8 Identify Traffic Ahead
- A-9 Self Separation

Ground Operations

- G-15 Taxi Guidance in Low Visibility

Time: 20 minutes

The weather conditions in this scenario are visibility to be less than a three miles. It could also take place at night.

In this scenario, the NASA aircraft is a light twin approaching Eagle Airport from the southwest. There is another general aviation aircraft flying traffic patterns at the airport. The NASA aircraft slowly descends from cruise altitude over treacherous terrain and enters the downwind. The NASA aircraft lands uneventfully. This scenario tests the ability of the pilot to perform a normal VMC approach and landing with the SVS under low visibility conditions.

SA Measurement

(1) Flight path adherence – The ability of the pilot to adhere to the desired flight path should be measured. This would include ability to maintain the required spacing from other aircraft, adherence to ATC commands, and deviations from glide slope. Horizontal and vertical distance from terrain and from traffic aircraft should also be recorded.

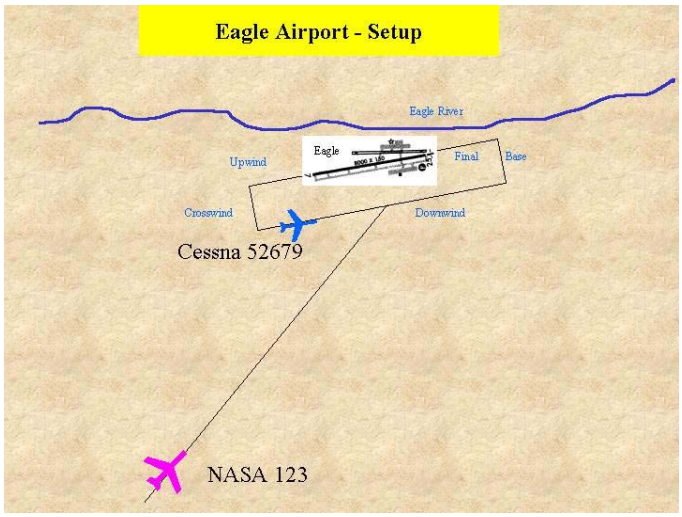
(2) SAGAT – The SA of the pilot should be measured via SAGAT queries at 3 different freeze points (at times 7.45, 11.21, and 16.26). Queries should include:

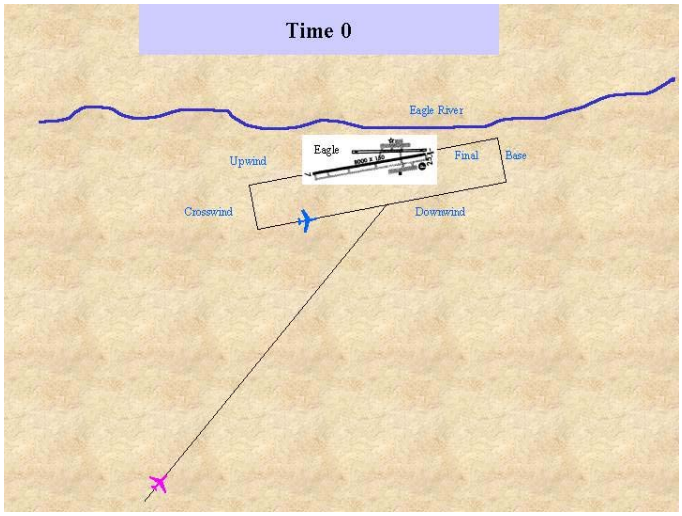
- Query 1 What is the current heading of your aircraft?
- Query 2 What is the current altitude of your aircraft?
- Query 3 What is the indicated airspeed of your aircraft?
- Query 4 What is the current rate of climb/descent of your aircraft?
- Query 5 What is the attitude of your aircraft (pitch and bank)?
- Query 7 How much fuel do you currently have?
- Query 8 What are the current winds?
- Query 14 Are you in conformance with your current clearance ?
- Query 15 Is there any conflicting traffic on your current flight path?
- Query 16 Conflicting traffic is currently located at (bearing and miles)?
- Query 17 Traffic Conflict Type
- Query 18 Is a change in path or altitude needed to avoid obstacles or terrain?

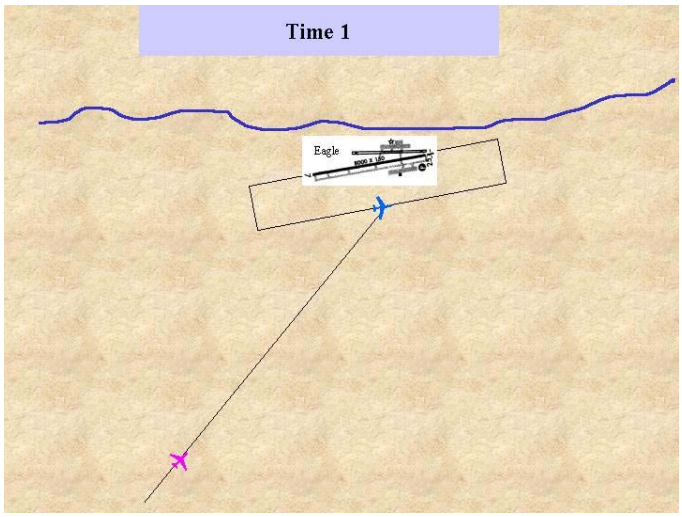
- Query 27 Are you on the proper glide path?
- Query 28 Where on the runway do you think you will touch down?
- Query 29 Where on the runway do you think you will stop the aircraft? (last stop only)
- Query 30 How far to the destination airport along your planned route of flight?
- Query 31 What is your current rate of closure on the aircraft in front of you?

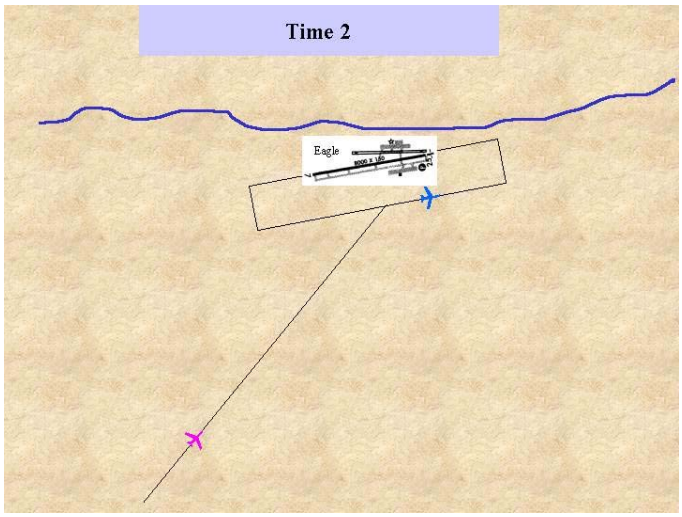
Scenarios for Assessing the Utility of Synthetic Visual Systems (SVS) in General Aviation Aircraft

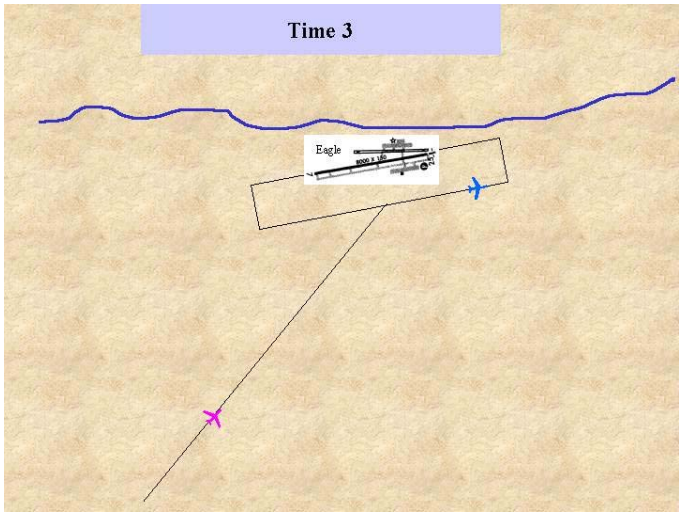
Scenario I - GA Traffic Pattern Entry and Landing in Challenging Terrain - Eagle Vail

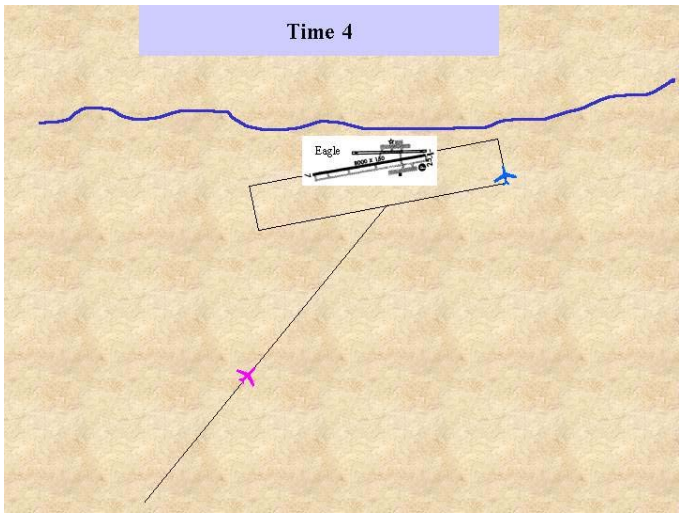


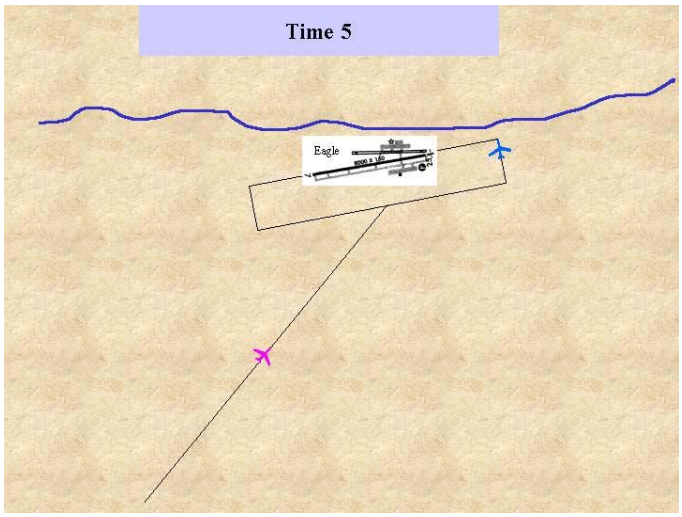


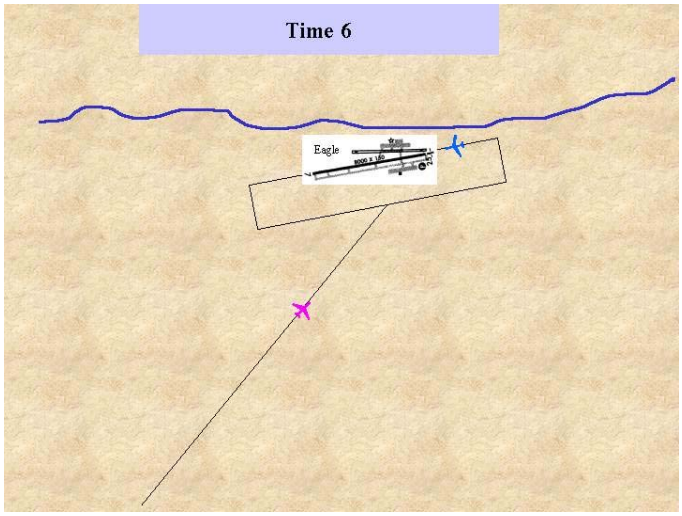

Time 1
Eagle

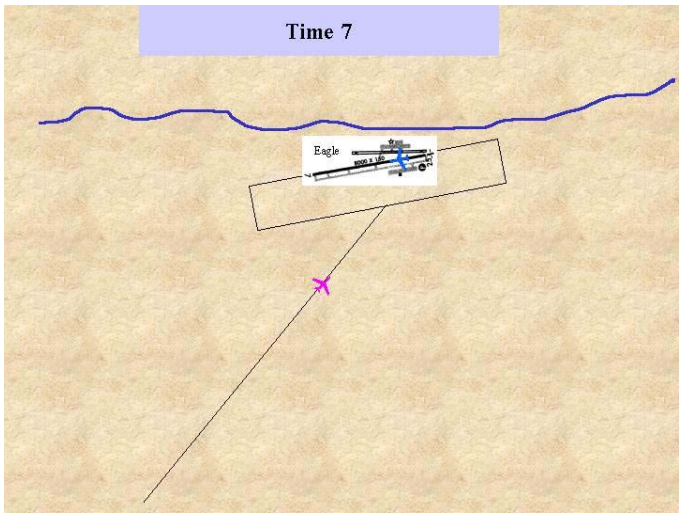

Time 2
Eagle


Time 3
Eagle


Time 4
Eagle


Time 5
Eagle


Time 6
Eagle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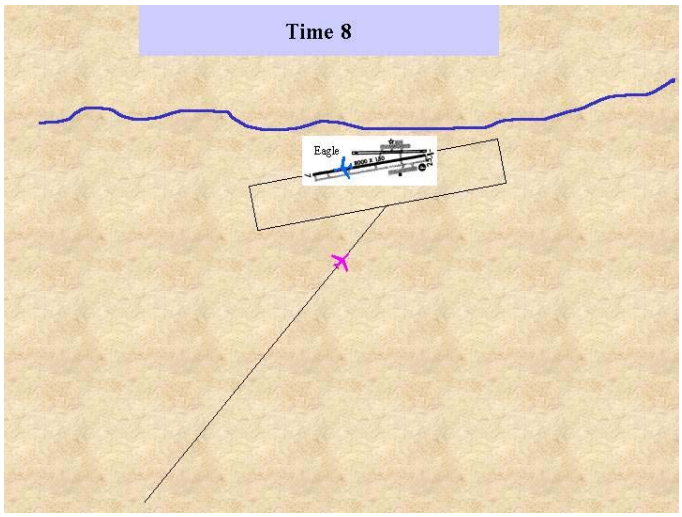
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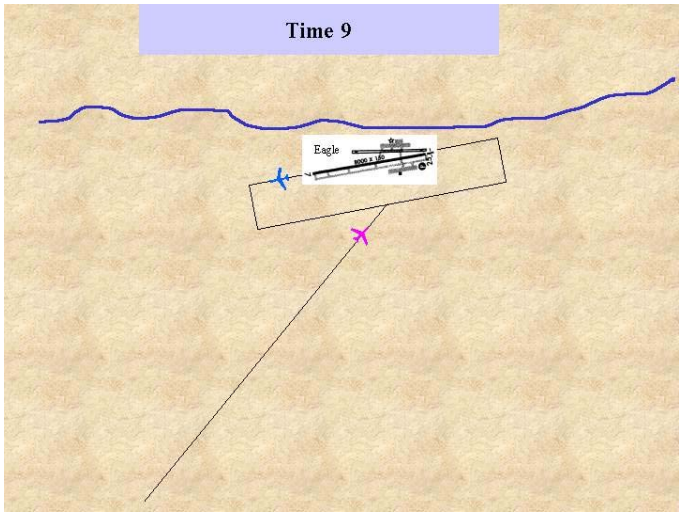
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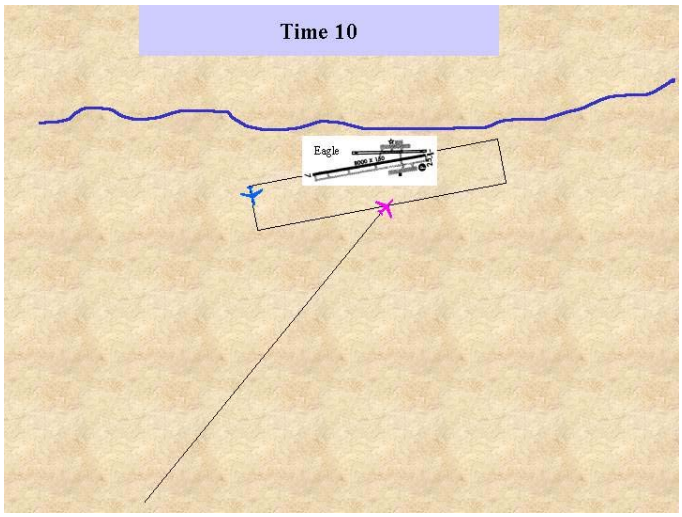
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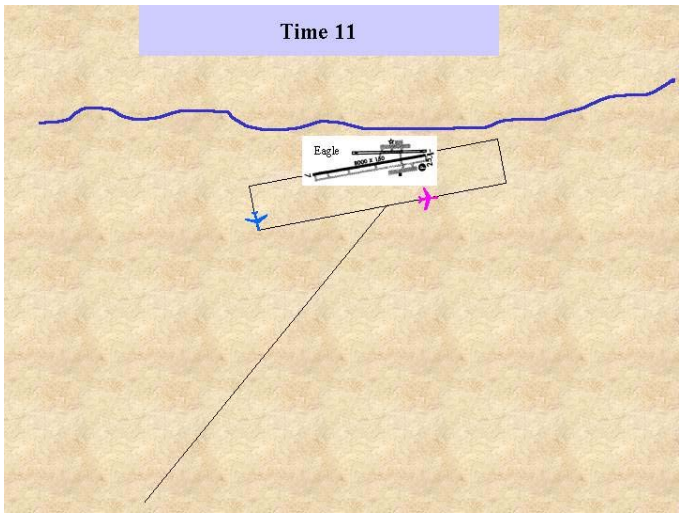
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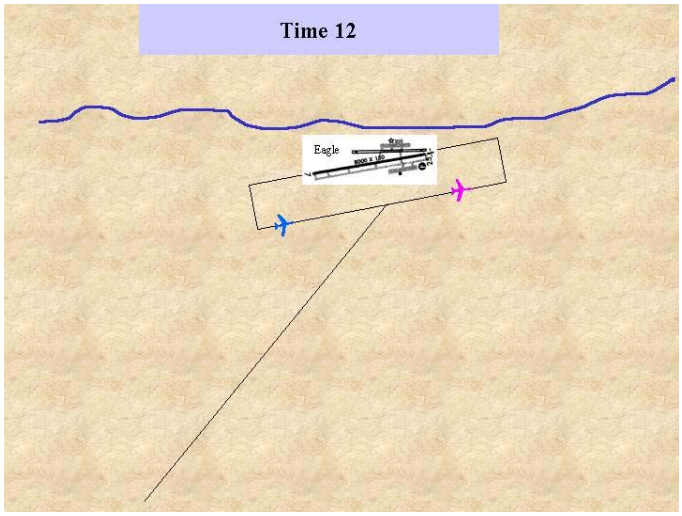
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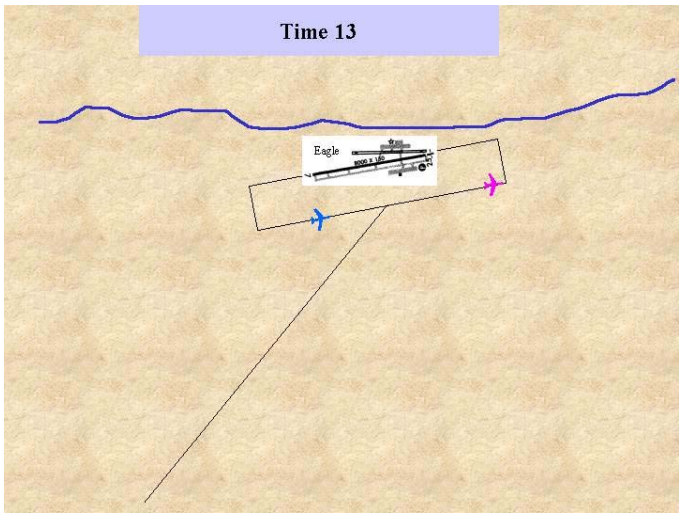
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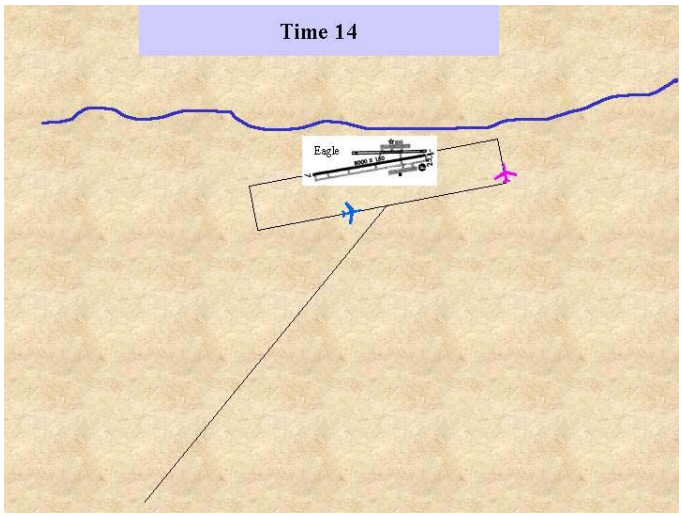
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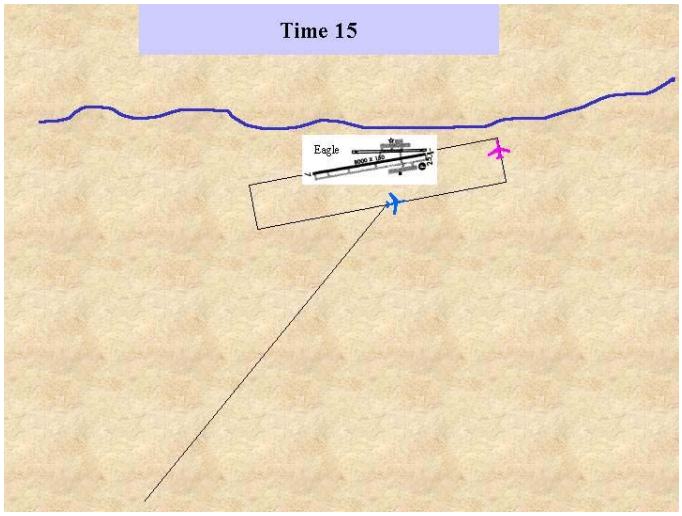
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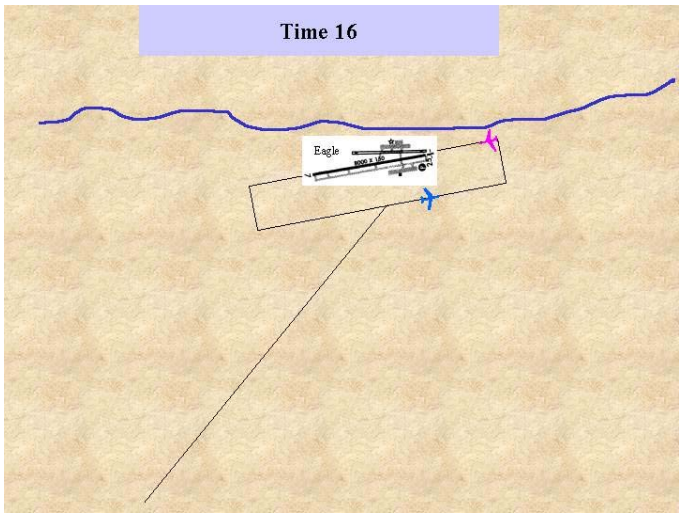
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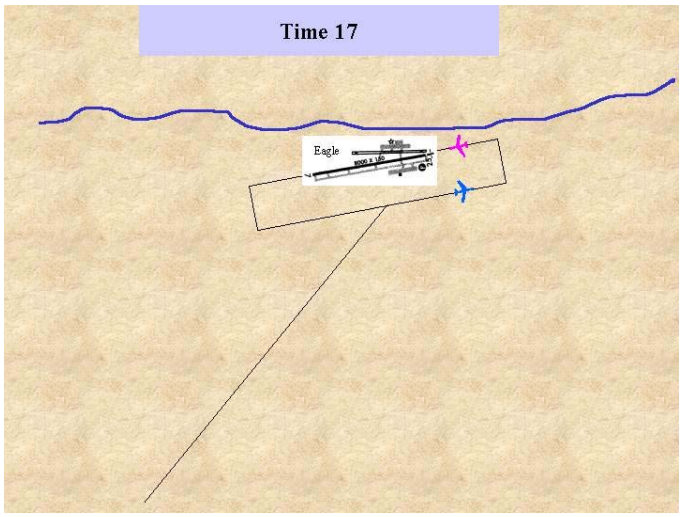
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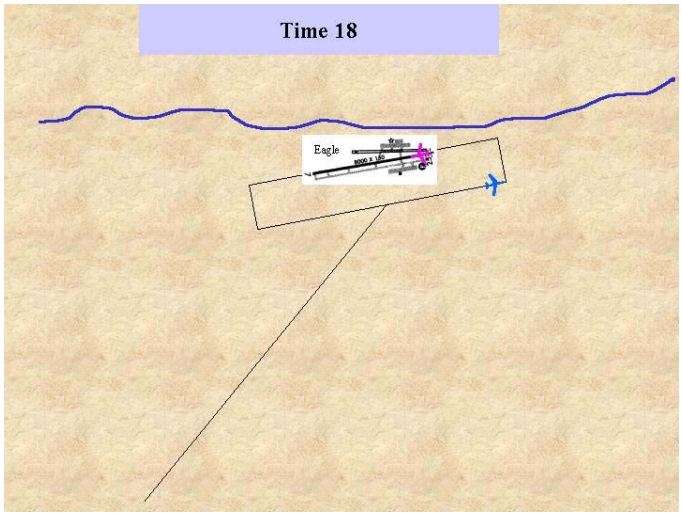
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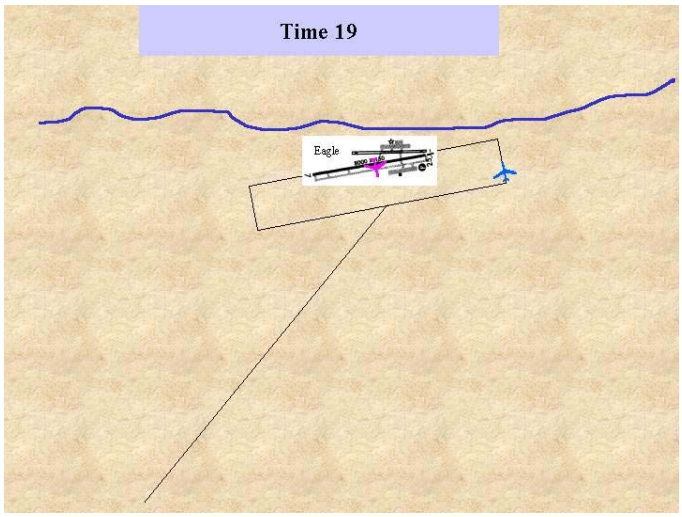
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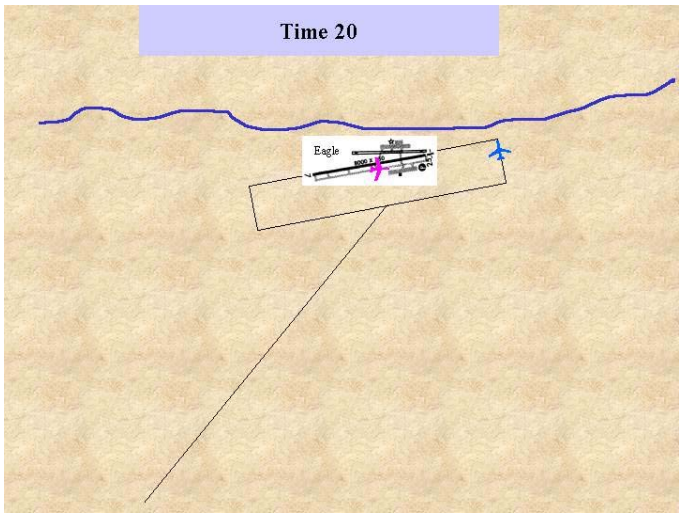

Time 20
Eagle

Scenario I – Aircraft Data

NASA123

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	taxiway A	6535	175	5	30	D	245	0
1	taxi off	6535	175	70	30	D	245	0
2	touchdown						245	0
3	final	6835	250	100	30		245	0
4	final	7000	250	100	30	D	245	0
5	base	7135	340	110	20	D	245	0
6	base	7235	340	120	20	D	245	0
7	base	7335	340	125	20	D	245	0
8	downwind	7435	070	130	10	D	245	0
9	downwind	7535	070	140	10	D	245	0
10	turn to dw	7535	030	140	U	U	245	0
11	inbound	7535	030	150	U	U	245	0
12	inbound	7535	030	160	U	U	245	0
13	inbound	7535	030	160	U	U	245	0
14	inbound	8500	030	160	U	U	245	0
15	inbound	9500	030	160	U	U	245	0
16	inbound	10500	030	160	U	U	245	0
17	inbound	11500	030	160	U	U	245	0
18	inbound		030	160	U	U	245	0
19	inbound	11500	030	160	U	U	245	0
20	inbound	11500	030	160	U	U	245	0

Time	Radio Traffic
0	NASA123 - taxi to the jet center
1	
2	NASA 123 - left on alpha 3, contact ground 121.8
3	
4	
5	
6	NASA123 - cleared to land runway 25
7	
8	
9	
10	NASA123 - roger, report turning base
11	
12	
13	
14	
15	NASA123 - report entering mid-field downwind runway 25, one in the pattern
16	
17	NASA123 - radar service terminated, squawk 1200, frequency change approved
18	
19	NASA123 - roger NASA123, continue
20	NASA123 - NASA123, switch frequency now 128.65

USAir298

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	base	7235	340	80	20	D	245	
1	base	7335	340	85	20	D	245	
2	downwind	7435	070	100	10	D	245	0
3	downwind	7535	070	100	10	D	245	0
4	downwind	7535	070	100	10	D	245	0
5	downwind	7535	070	100	0	U	245	0
6	downwind	7535	070	100	0	U	245	0
7	downwind	7535	070	100	0	U	245	0
8	downwind	7535	070	85	0	U	245	0
9	crosswind	7235	160	75	0	U	245	0
10	crosswind	7035	160	75	0	U	245	0
11	upwind	6835	250	75	0	U	245	0
12	t/o roll	6535	250	55	0	D	245	0
13	touchdown	6535	250	50	30	D	245	0
14	final	6835	250	65	30	D	245	0
15	base	7235	340	80	20	D	245	0
16	base	7335	340	85	20	D	245	0
17	downwind	7435	070	95	10	D	245	0
18	downwind	7535	070	100	10	D	245	0
19	downwind	7535	070	100	U	U	245	0
20	downwind	7535	070	100	U	U	245	0

Time	Radio Traffic
0	
1	
2	
3	
4	
5	
6	
7	
8	Cessna52679 - follow that traffic, cleared for the option runway 25
9	Cessna52679 - do you have the traffic on downwind in sight?
10	
11	Cessna52679 - traffic will entering the midfield downwind from the southwest, report that traffic in sight
12	
13	
14	
15	
16	
17	
18	
19	
20	

ATC Master Communication Log- GA Scenario I

Air Traffic Controller Radio Communications

Scripted Radio Calls from Other Aircraft

NASA 123 Radio Suggested Radio Calls

Time 0

NASA123, switch frequency to 128.65 for further flight following
NASA123, roger, switching to 128.65, good day

Time 1

Denver center, NASA123, level at 11,500 ft
Roger NASA123, continue
NASA123, wilco

Time 2

Time 3

NASA123, radar service terminated, squawk 1200, frequency change approved
Roger, squawking 1200

Time 4

Time 5

Eagle tower, NASA 123 inbound from the southwest descending out of 9500 feet for traffic pattern altitude, full stop
Roger, NASA123, report entering mid-field downwind for runway 25. There is one aircraft in the pattern
(Read back clearance)

Time 6

Time 7

Time 8

Time 9

Cessna52679, traffic will be entering the midfield downwind from the southwest, report that traffic in sight
(Read back clearance)

Time 10

Eagle tower, NASA123, entering the midfield downwind
Roger, NASA123, report turning base
(Read back clearance)

Time 11

Cessna52679, do you have that traffic in sight?
Negative tower, we're looking for him, Cessna 52679

Time 12

Cessna 52679 has the downwind traffic in sight
Roger Cessna 52679, follow that traffic cleared for the option runway 25
(Read back clearance)

Time 13

Time 14

NASA123 on base for runway 25
Roger NASA 123, cleared to land runway 25
(Read back clearance)

Time 15

Time 16

Time 17

Time 18

NASA123, turn left alpha 3 and contact ground 121.8
(Read back clearance)

Time 19

Eagle ground, NASA 123 off of runway 25 at alpha 3, taxi jet center
Roger NASA 123, taxi jet center
(Read back clearance)

Time 20

Line Oriented Evaluation Scenario J

Ground Operations, Taxi and Departure

The following GA SVS CONOPS applications are tested in this scenario.

Ground Operations

- G-2 Aircraft Clearance Awareness
- G-6 Runway Incursion Detection and Accident Prevention
- G-13 Speed Awareness
- G-15 Taxi Guidance in Low Visibility
- G-18 Taxiway Excursions

Departure

- D-6 VFR Separation
- D-17 Navigation (SIDs)

This scenario takes place at Reagan National Airport. Visibility is 3 miles with haze. The ceiling is 3500 feet overcast. The NASA aircraft (NASA 123) begins taxiing from the general aviation (GA) ramp to runway 19. As it taxi's out, another GA aircraft is told to taxi inbound to the GA ramp. Since these aircraft use parallel taxiways, no conflict is produced. As NASA 123 continues to taxi, an airliner, USAIR 298 taxi's from the commercial ramp to runway 19. Due to spacing, NASA 123 is told to follow USAIR 298 to the runway. Shortly thereafter, USAIR 298 is told to cross runway 15 while CALEX 1212 is on approach. After USAIR 298 crosses, NASA 123 is told to cross runway 15 just as CALEX 1212 lands. After CALEX 1212 clears the runway, USAIR 298 is cleared for takeoff. NASA 123 is told to hold short of runway 19 while Delta 332 approaches for landing. After Delta 332 lands and clears the runway, NASA 123 takes off uneventfully.

SA Measurement

(1) Ground and Flight path adherence – The ability of the pilot to adhere to the cleared taxiways and runways should be measured. This would include ability to maintain the required spacing from other aircraft, adherence to ATC commands, and deviations from clearances. Any movement of the aircraft across the runway while the intruder aircraft is present on the runway should be measured. Verbalizations or other actions indicating detection of the intruder aircraft should be measured.

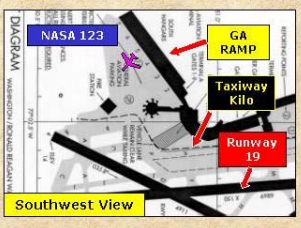
(2) SAGAT – The SA of the pilot should be measured via SAGAT queries at 3 different freeze points (at times 5.12, 7.45, and 17.30). Queries should include:

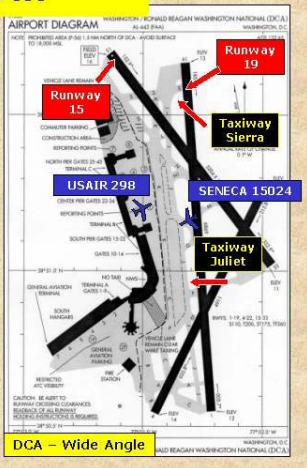
- Query 1 What taxiway/runway are you currently on?
- Query 8 What are the current winds?
- Query 14 Are you in conformance with your current clearance?
- Query 15 Is there any conflicting traffic on your current path?
- Query 16 Conflicting traffic is currently located at (bearing and miles)?
- Query 17 Traffic conflict type
- Query 18 Is a change in path or altitude needed to avoid obstacles or terrain?
- Query 30 How far to the destination airport along your planned route of flight?
- Query 31 What is your current rate of closure on the aircraft in front of you?

Scenarios for Assessing the Utility of Synthetic Visual Systems (SVS) in General Aviation Aircraft

Scenario J - Ground Operations, Taxi and Departure

Set Up - DCA





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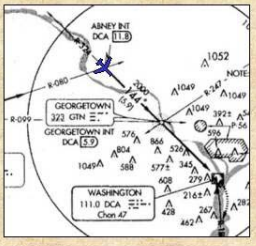

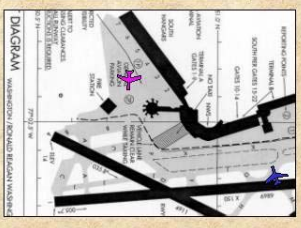

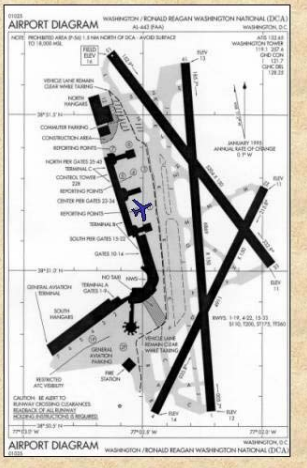

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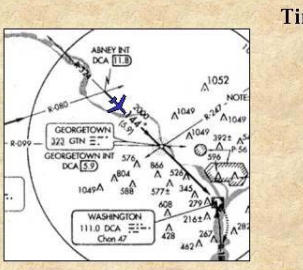

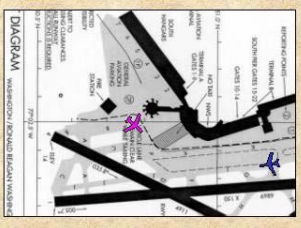

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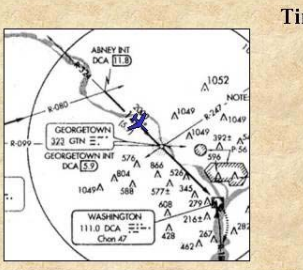

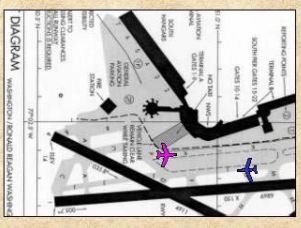

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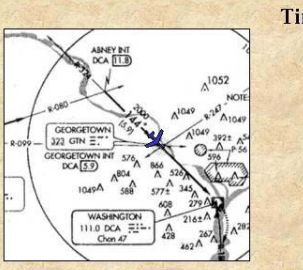

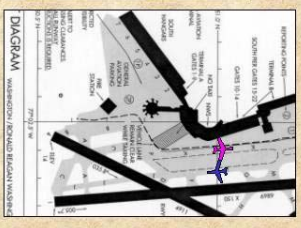

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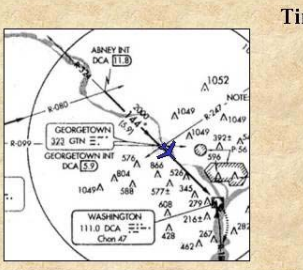

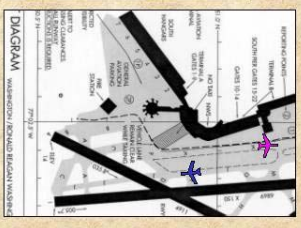

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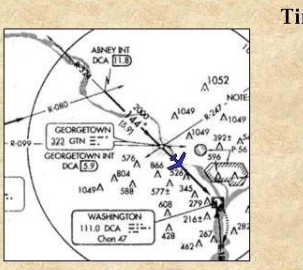

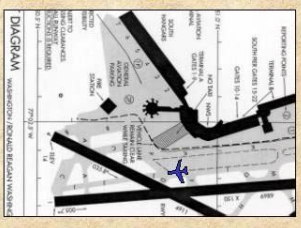

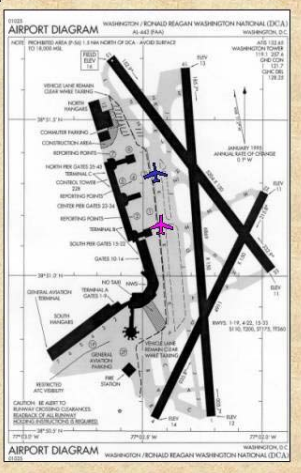

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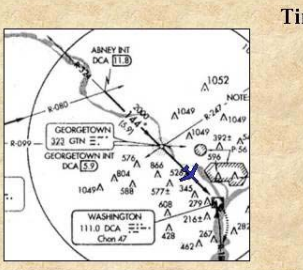

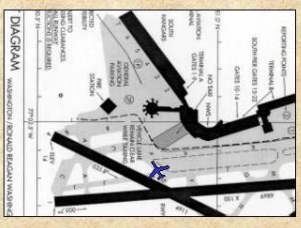

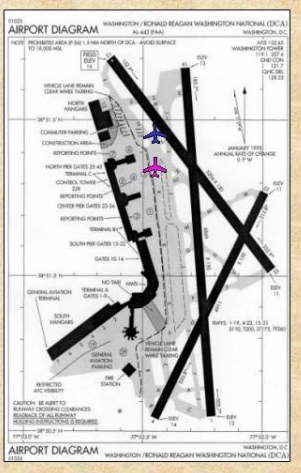

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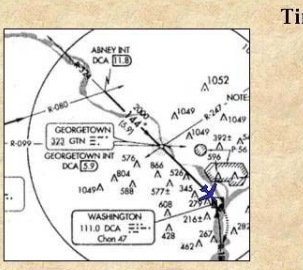

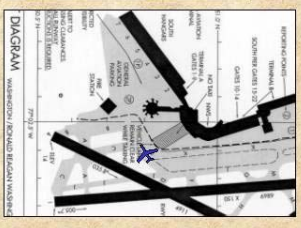

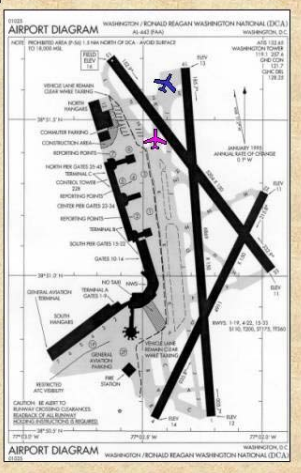

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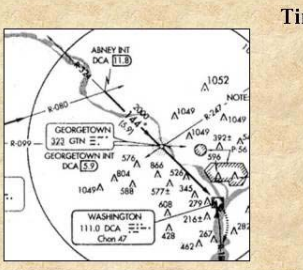

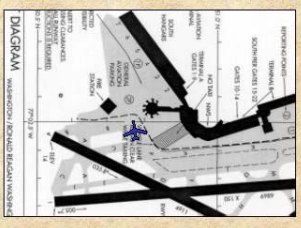

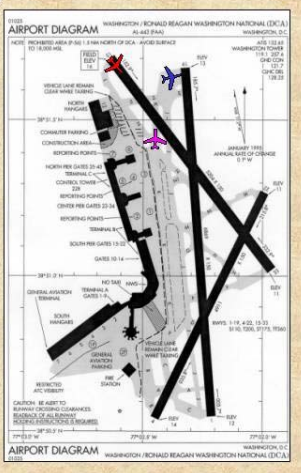

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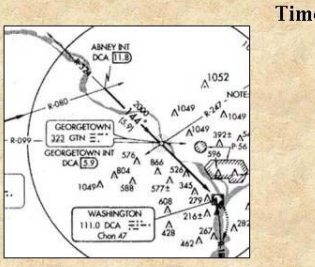
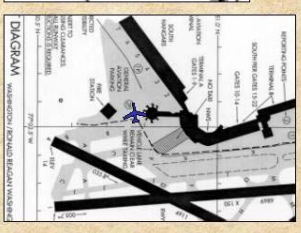
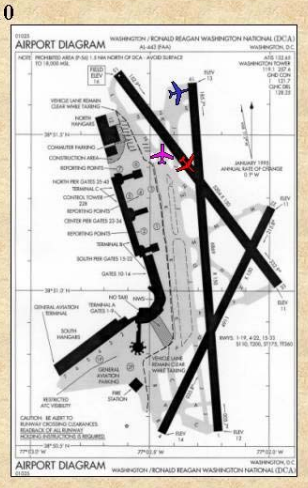
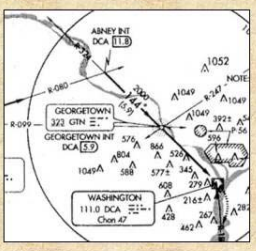
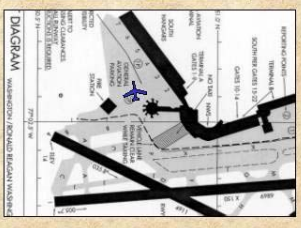


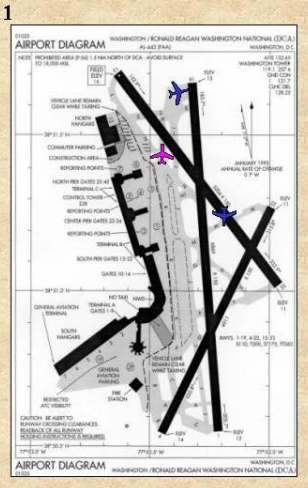




Time 11







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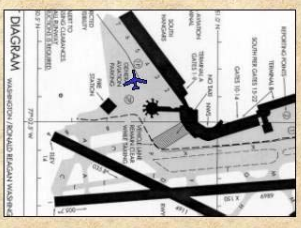

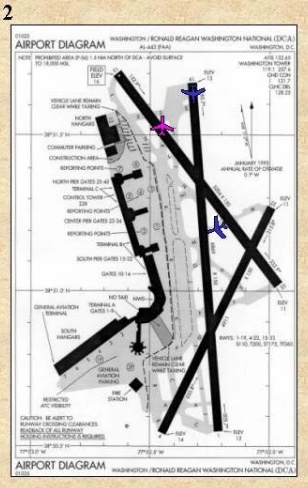

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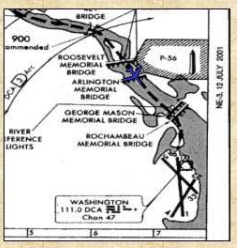

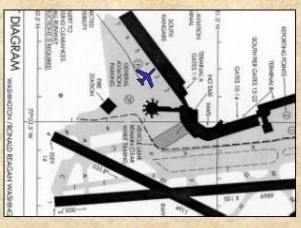

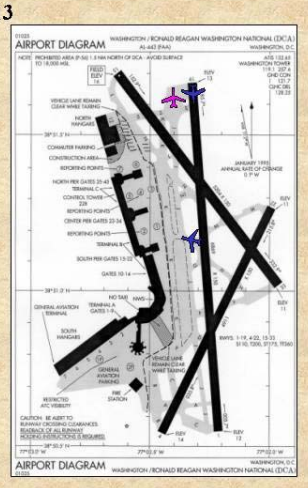

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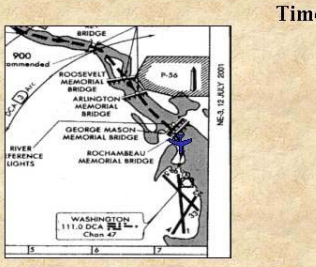

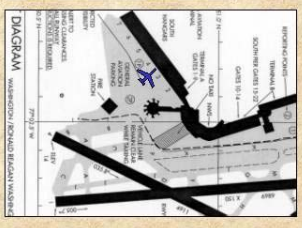

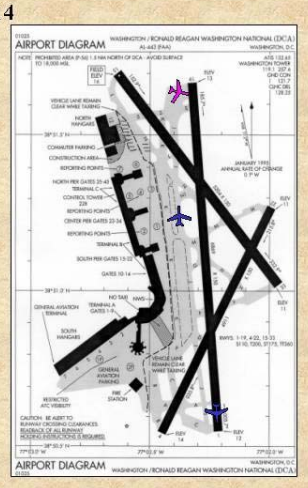

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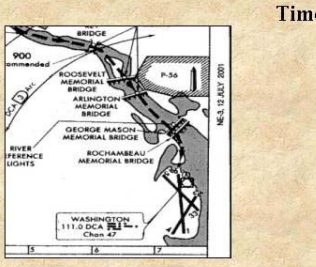

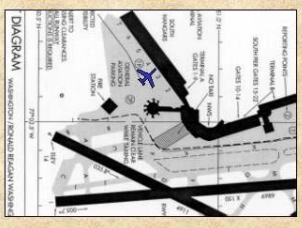

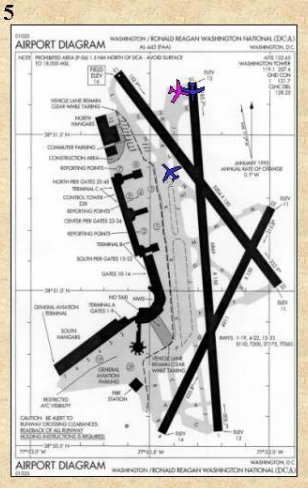

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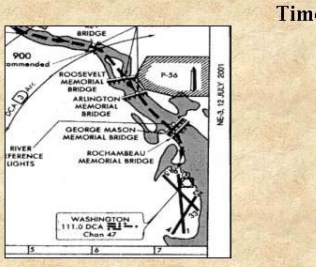

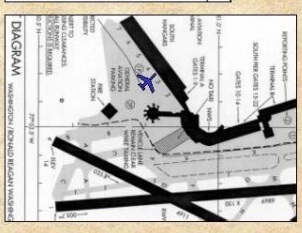

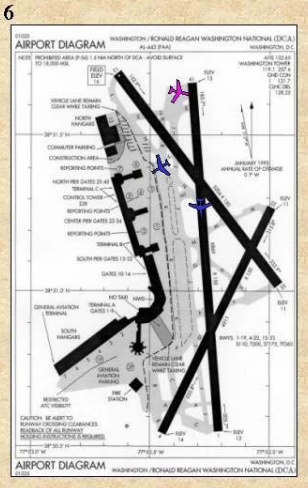

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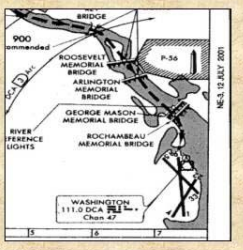

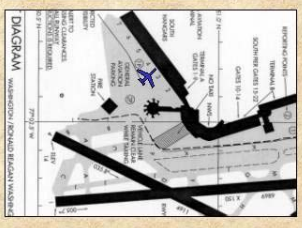

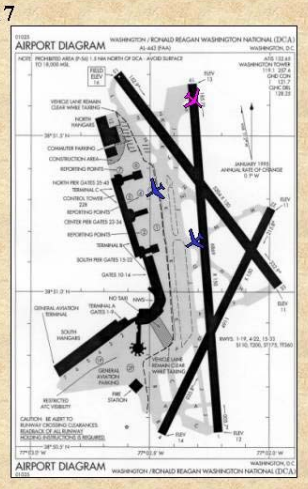

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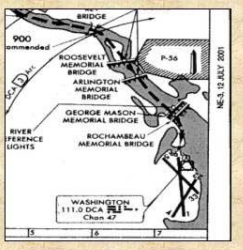

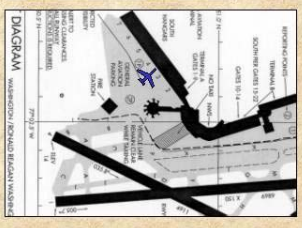

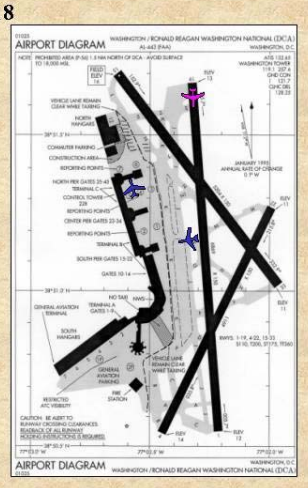

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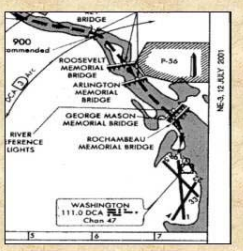

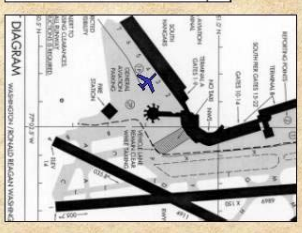

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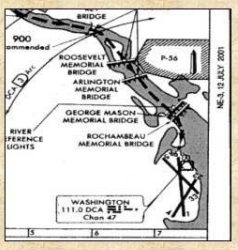

900
ROOSEVELT MEMORIAL BRIDGE
ARLINGTON MEMORIAL BRIDGE
GEORGE MASON MEMORIAL BRIDGE
ROCHAMBEAU MEMORIAL BRIDGE
RIVER FERENCE LIGHTS
P-56
WASHINGTON
111.0 DCA
Chan 47
NGS, 12 JULY 2001

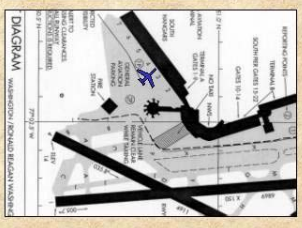


DIAGRAM
WASHINGTON /RONALD REAGAN WASHINGTON


AIRPORT DIAGRAM
WASHINGTON /RONALD REAGAN WASHINGTON NATIONAL (DCA)
AIRPORT DIAGRAM
WASHINGTON /RONALD REAGAN WASHINGTON NATIONAL (DCA)

Scenario J – Aircraft Data

NASA123

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	GA Ramp	16	010	0	U	D	170	0
1	To Kilo	16	010	10	U	D	170	0
2	Kilo	16	010	10	U	D	170	0
3	Kilo	16	010	10	U	D	170	0
4	Kilo	16	010	10	U	D	170	0
5	Kilo	16	010	10	U	D	170	0
6	Kilo	16	010	10	U	D	170	0
7	Kilo Hold	16	010	0	U	D	170	0
8	Kilo Hold	16	010	0	U	D	170	0
9	Kilo Hold	16	010	0	U	D	170	0
10	Kilo Hold	16	010	0	U	D	170	0
11	Cross 15	16	010	10	U	D	170	0
12	Hold Short	16	140	0	U	D	170	0
13	Hold Short	16	140	0	U	D	170	0
14	Hold Short	16	140	0	U	D	170	0
15	Hold Short	16	140	0	U	D	170	0
16	Taxi onto 19	16	080	10	U	D	170	0
17	Hold on 19	16	190	0	U	D	170	0
18	Takeoff	100	190	135	U	U	170	0
19	Airborne	500	190	200	U	U	170	0

Time	Radio Traffic
0	Roger NASA123, taxi runway 19 via kilo and sierra, hold short runway 15
1	
2	
3	
4	NASA 123, follow traffic ahead to runway 19, hold short of runway 15
5	
6	
7	
8	NASA 123, cleared to cross runway 15, taxi to runway 19
9	
10	
11	
12	
13	
14	Roger NASA 123, hold short, landing traffic
15	
16	NASA 123, taxi into position and hold runway 19
17	
18	NASA123 cleared for take off runway 19
19	

Seneca 15024

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	Hold Mike	16	260	0	U	D	170	0
1	Juliet	16	190	10	U	D	170	0
2	Juliet	16	190	10	U	D	170	0
3	Juliet	16	190	10	U	D	170	0
4	Juliet	16	190	10	U	D	170	0
5	Juliet	16	190	10	U	D	170	0
6	Papa	16	260	10	U	D	170	0
7	Papa	16	260	10	U	D	170	0
8	Papa	16	260	10	U	D	170	0
9	GA Ramp	16	260	10	U	D	170	0
10	GA Ramp	16	260	10	U	D	170	0
11	GA Ramp	16	260	10	U	D	170	0
12	Hangar	16	010	0	U	D	170	0

Time	Radio Traffic
0	Seneca 15024 - Taxi to GA ramp via juliet and papa, give way to the aircraft departing GA ramp
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

CALEX 1212

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	ABNEY	2500	144	195	5	U	170	0
1	FAC*	2250	144	180	15	D	170	0
2	FAC*	2100	144	180	15	D	170	0
3	GTN	2000	144	180	15	D	170	0
4	FAC*	1500	144	180	15	D	170	0
5	FAC*	1000	144	180	15	D	170	0
6	FAC*	500	144	180	15	D	170	0
7	FAC*	50	144	180	15	D	170	0
8	Touchdown	16	144	120	0	D	170	0
9	Rollout 15	16	144	40	0	D	170	0
10	Exit Rwy	16	250	10	0	D	170	0
11	Mike	16	250	10	0	D	170	0
12	Cross 19	16	260	10	0	D	170	0
13	Juliet	16	010	10	0	D	170	0
14	November	16	330	10	0	D	170	0
15	Enter Ramp	16	250	10	0	D	170	0
16	Term C	16	010	10	0	D	170	0
17	Gate 35	16	010	0	0	D	170	0

Time	Radio Traffic
0	CALEX 1212, switch to tower 119.1
1	Roger CALEX 1212, cleared to land runway 15
2	
3	
4	
5	
6	
7	
8	CALEX 1212, turn right taxiway mike and contact ground 121.7 when clear
9	
10	CALEX 1212, taxi across runway 19 to gate 35 via juliet
11	
12	
13	
14	
15	
16	
17	
18	

*FAC=Final approach course on VOR RWY 15 Instrument Approach Chart: 144 degrees magnetic

USAir298

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	Gate 31	16	010	0	0	D	170	0
1	Gate 31	16	010	0	0	D	170	0
2	Gate 31	16	010	0	0	D	170	0
3	Gate 31	16	010	0	0	D	170	0
4	Kilo	16	010	10	0	D	170	0
5	Kilo	16	010	10	0	D	170	0
6	Kilo	16	010	10	0	D	170	0
7	Cross 15	16	080	10	0	D	170	0
8	Sierra	16	080	10	0	D	170	0
9	Hold Short	16	080	0	0	D	170	0
10	Hold Short	16	190	0	0	D	170	0
11	Hold on 19	16	190	0	0	D	170	0
12	Hold on 19	16	190	0	0	D	170	0
13	Takeoff	100	190	160	0	U	170	0

Time	Radio Traffic
0	
1	
2	
3	
4	USAIR 298, taxi runway 19 via kilo and sierra, hold short of runway 15
5	
6	USAIR 298, cleared to cross runway 15, taxi to runway 19
7	
8	
9	
10	
12	USAIR 298, taxi into position and hold, runway 19
13	USAIR 298, runway 19 cleared for takeoff
14	

Delta 332

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
12	Key Bridge	900	010	180	30	D	170	0
13	Arlington Bridge	900	148	180	30	D	170	0
14	Final 19	400	148	180	30	D	170	0
15	Touchdown	16	190	120	30	D	170	0
16	Rollout	16	190	40	30	D	170	0
17	Hold Mike	16	190	0	0	D	170	0
18	Hold Mike	16	250	0	0	D	170	0
19	Hold Mike	13	250	0	0	D	170	
20	Juliet	16	250	10	0	D	170	0

Time	Radio Traffic
12	DELTA 332, continue
13	
14	DELTA 332 cleared to land runway 19
15	
16	
17	DELTA 332, turn right on taxiway mike, contact ground 121.7 when clear
18	
19	
20	

ATC Master Communication Log- SVS GA Scenario J

Air Traffic Controller Radio Communications

Scripted Radio Calls from Other Aircraft

NASA 123 Radio Suggested Radio Calls

Time 0

Time 1

[Ground Control]
Washington ground, NASA123 at GA ramp, with clearance, taxi active
Roger NASA123, taxi runway 19 via kilo and sierra, hold short runway 15
(Readback)
Washington ground, Seneca 15024, taxi GA ramp
Roger Seneca 15024, taxi via juliet and papa, give way to traffic leaving GA ramp
(Readback)

Time 2

[Approach Control]
CALEX 1212, switch to tower 119.1
Roger approach, going to tower

Time 3

[Tower]
Tower, CALEX 1212, inbound VOR runway 15
Roger CALEX 1212, cleared to land runway 15
(Read back clearance)

Time 4

Time 5

[Ground control]
Ground, USAIR 298, gate 31, with clearance, taxi active
USAIR 298, taxi runway 19 via kilo and sierra, hold short of runway 15
(Read back clearance)
NASA 123, follow traffic ahead to runway 19, hold short of runway 15
(Readback clearance)

Time 6

Time 7

USAIR 298, cleared to cross runway 15, taxi to runway 19
(Read back clearance)

Time 8

Time 9

NASA 123, cleared to cross runway 15, taxi to runway 19
(Read back clearance)

Time 10

[Tower]
CALEX 1212, turn right taxiway mike and contact ground 121.7 when clear
(Read back clearance)

Time 11

Time 12

[Tower]
Tower, DELTA 332 over key bridge, inbound visual runway 19
Roger, DELTA 332, continue
(Read back clearance)
USAIR 298, taxi into position and hold, runway 19
(Read back clearance)

[Ground]
Ground, CALEX 1212 off runway 19 at mike, taxi gate 35
CALEX 1212, taxi across runway 19 to gate 35 via juliet
(Read back clearance)

Time 13

[Tower]
USAIR 298, runway 19 cleared for takeoff
(Read back clearance)

Time 14

DELTA 332 cleared to land runway 19
(Read back clearance)

Time 15

[Tower]
Tower, NASA 123 ready for takeoff runway 19
Roger NASA 123, hold short, landing traffic
(Read back clearance)

Time 16

Time 17

[Tower]
DELTA 332, turn right on taxiway mike, contact ground 121.7 when clear

(Read back clearance)
NASA 123, taxi into position and hold runway 19
(Read back clearance)

Time 18

Time 19

[Tower]
NASA123 cleared for take off runway 19
(Read back clearance)

Time 20

Line Oriented Evaluation Scenario K

GA Traffic Pattern Entry and Landing in Challenging Terrain - Asheville

SVS Aspects Tested: The following GA SVS CONOPS applications are tested in this scenario.

Approach

- A-5 Terrain Avoidance Equivalent to VMC
- A-8 Identify Traffic Ahead
- A-9 Self Separation
- A-17 Improved Approaches in Challenging Terrain

Time: 20 minutes

This scenario is taking place at a field (Asheville Regional) whose tower has closed for the evening. Therefore, the field is considered uncontrolled with uncontrolled Class G airspace overhead. At night, an aircraft may fly in the pattern within _ sm of the field as long as they remain clear of clouds and ground visibility does not drop below 1 sm--in accordance with Federal Aviation Regulation 91.155(b). Some GA pilots bend this rule a bit, as depicted in this scenario. For simplicity, this log depicts both radio communication and actions performed by the participating aircraft.

Setting:
Time: 23:30 (tower has shut down, airport has reverted to an uncontrolled field)
Ceiling: 1000 feet AGL
Visibility: 1 sm
Wind: 160 degrees at 5 knots

Background:

Cessna 52679 is visiting Asheville for the first time and is "scud" running a bit in the pattern to make it into the airport. He is not communicating.
Seneca 15024 & *Cessna 9481U* are departing VFR and will subsequently pick up IFR clearances (not depicted here.)
NASA 123 is inbound on the ILS runway 16 approach.
Mooney 11AE is trying to depart without communicating with anyone.

SA Measurement

(1) Flight path adherence – The ability of the pilot to adhere to the desired flight path should be measured. This would include ability to maintain the required spacing from other aircraft, adherence to ATC commands, and deviations from glide slope. Horizontal and vertical distance from terrain and from traffic aircraft should also be recorded.

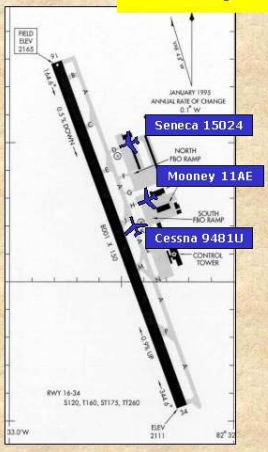
(2) SAGAT – The SA of the pilot should be measured via SAGAT queries at 3 different freeze points (at times 3.56, 8.51, and 16.55). Queries should include:

- Query 1 What is the current heading of your aircraft?
- Query 2 What is the current altitude of your aircraft?
- Query 3 What is the indicated airspeed of your aircraft?
- Query 4 What is the current rate of climb/descent of your aircraft?
- Query 5 What is the attitude of your aircraft (pitch and bank)?
- Query 7 How much fuel do you currently have?
- Query 8 What are the current winds?
- Query 14 Are you in conformance with your current clearance ?
- Query 15 Is there any conflicting traffic on your current flight path?
- Query 16 Conflicting traffic is currently located at (bearing and miles)?
- Query 17 Traffic Conflict Type
- Query 18 Is a change in path or altitude needed to avoid obstacles or terrain?
- Query 27 Are you on the proper glide path?
- Query 28 Where on the runway do you think you will touch down?
- Query 29 Where on the runway do you think you will stop the aircraft? (last stop only)
- Query 30 How far to the destination airport along your planned route of flight?
- Query 31 What is your current rate of closure on the aircraft in front of you?

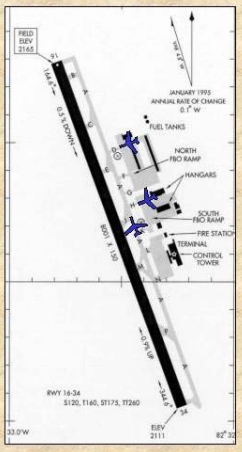
Scenarios for Assessing the Utility of Synthetic Visual Systems (SVS) in General Aviation Aircraft

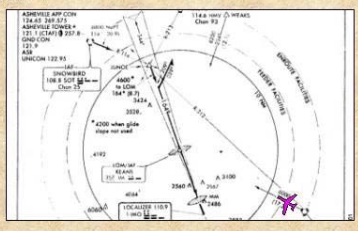
Scenario K - GA Traffic Pattern Entry and Landing in Challenging Terrain - Asheville

Set Up - Asheville Airport



Time 1





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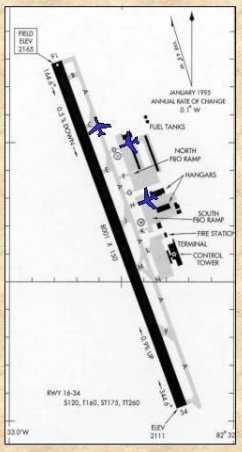
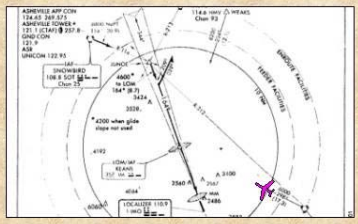
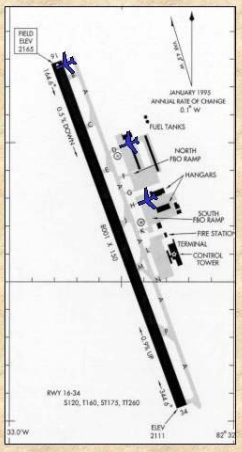
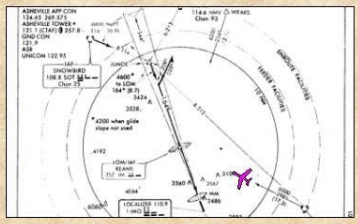




Time 3





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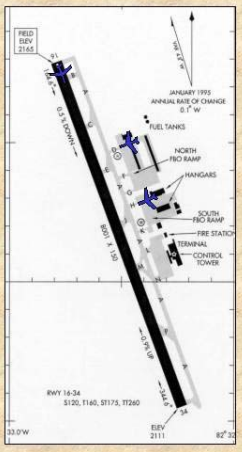
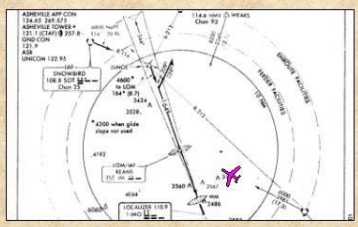
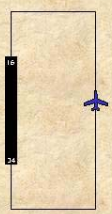
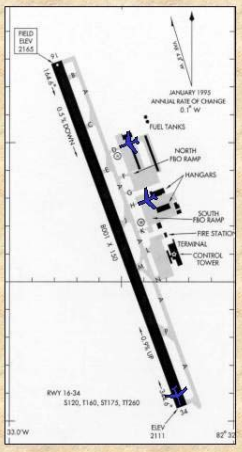
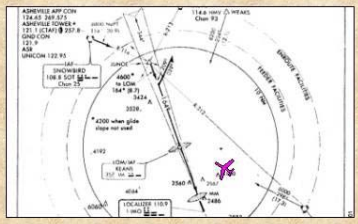






Time 5





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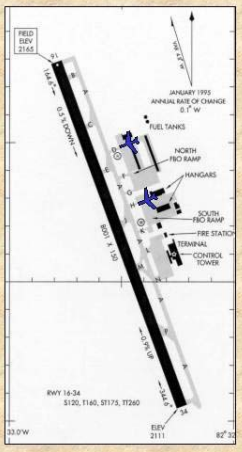

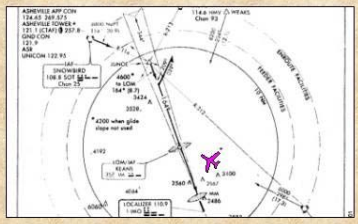

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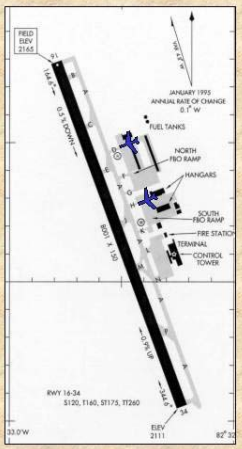

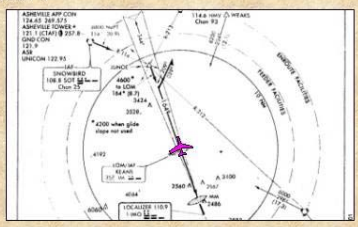

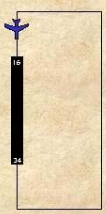

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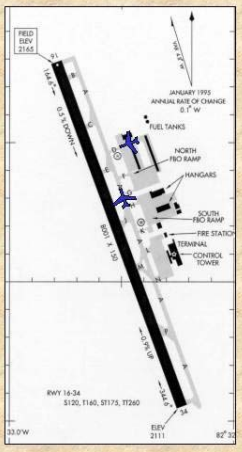

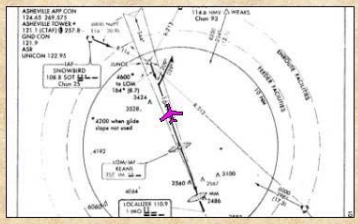

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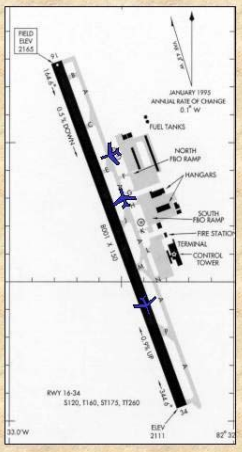
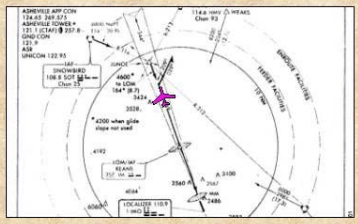
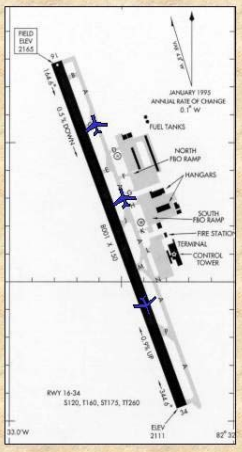
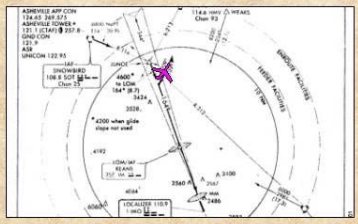




Time 10





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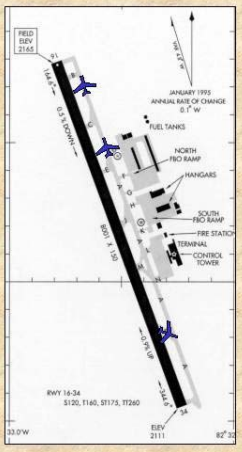

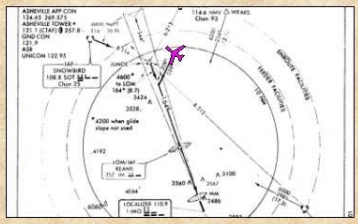

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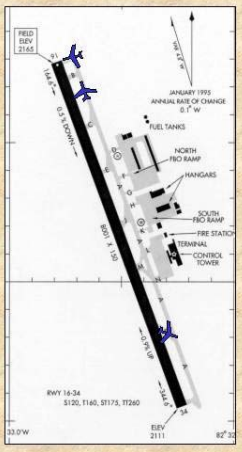
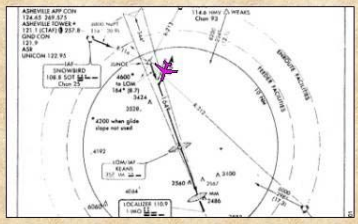
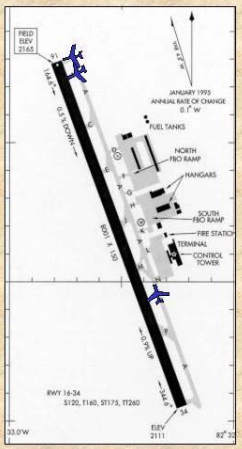
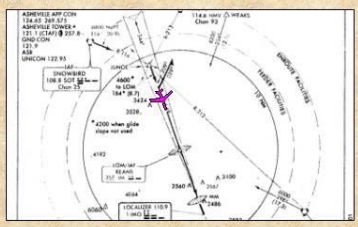


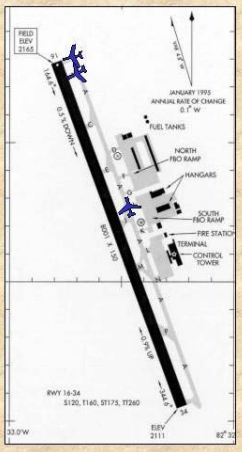


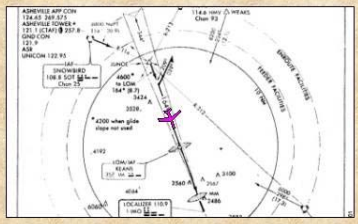
Time 13



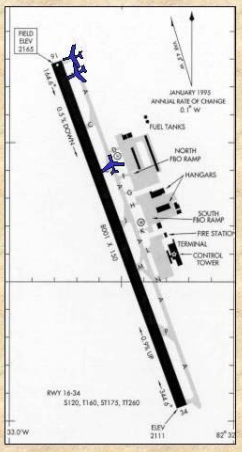


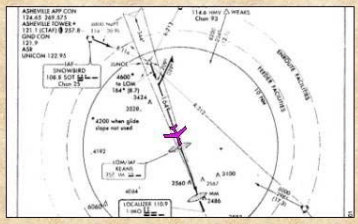
Time 14



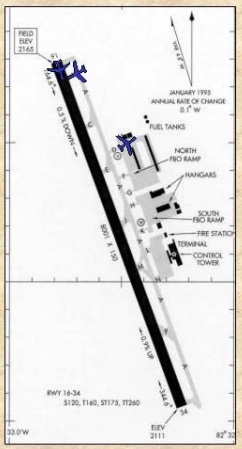


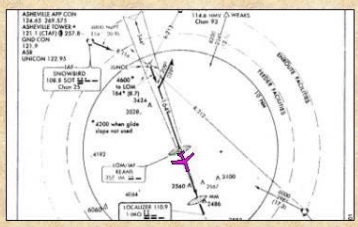
Time 15



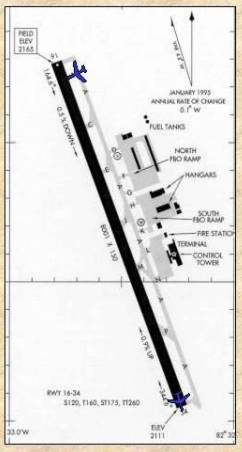


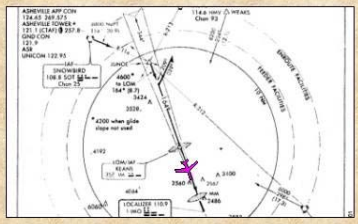
Time 16



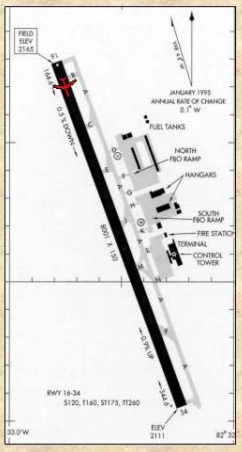


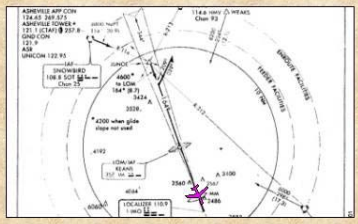
Time 17



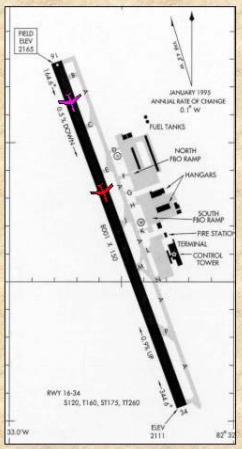


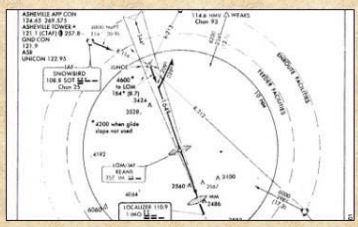
Time 18



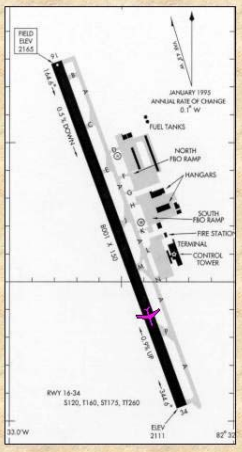


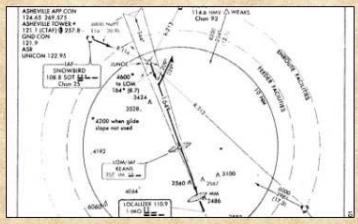
Time 19

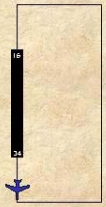




Time 20


FIELD ELEV 2165
JANUARY 1995
ANNUAL RATE OF CHANGE
0.1° W
FUEL TANKS
NORTH FBO RAMP
HANGARS
SOUTH FBO RAMP
FIRE STATION
TERMINAL
CONTROL TOWER
RWY 16-34
S120, T160, ST175, TT260
ELEV 2111


ASHEVILLE APP CON
ASHEVILLE TOWER
GND CON
ATIS
UNICOM 122.95
SNOWBIRD
4200 when glide slope not used
TERRAIN FEATURES


16
34

Scenario K - Aircraft Data

NASA123

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
1	Sugarloaf 298 radial	6000	298	120	U	U	170	0
2	Sugarloaf 298 radial	6000	298	120	U	U	170	0
3	Sugarloaf 298 radial	6000	298	120	U	U	170	0
4	Sugarloaf 298 radial	6000	298	120	U	U	170	0
5	Sugarloaf 298 radial	6000	298	120	U	U	170	0
6	Sugarloaf 298 radial	6000	298	120	U	U	170	0
7	Over KEANS	6000	344	120	U	U	170	0
8	FAC* Outbound	5500	344	110	10	U	170	0
9	FAC* Outbound	5100	344	100	10	U	170	0
10	PT* Outbound	5100	029	100	10	U	170	0
11	PT* Turning Inbound	5100	344	100	10	U	170	0
12	PT* Inbound	5100	209	100	10	U	170	0
13	FAC* Inbound	5100	164	100	10	U	170	0
14	FAC* Inbound	5100	164	100	10	U	170	0
15	FAC* Inbound	5100	164	100	10	U	170	0
16	FAC* (GS Intercept)	4600	164	100	10	D	170	0
17	GS Inbound	3100	164	100	10	D	170	0
18	Over Mid Marker	2500	164	100	10	D	170	0
19	Touchdown	2165	164	70	30	D	170	0
20	Rollout	2165	164	30	30	D	170	0

Time	Radio Traffic
1	NASA 123, proceed direct keans, cleared for ILS runway 16 approach, report procedure turn inbound
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	NASA 123, tower is closed at Asheville, no traffic observed in the pattern, switch to Unicom 122.95
13	
14	NASA 123 – Asheville Unicom, NASA 123 inbound ILS 16, 7 miles out
15	
16	
17	NASA 123 – Asheville Unicom, NASA 123, inbound on ILS runway 16, 5 miles out
18	
19	
20	

*FAC = Final Approach Course

*PT= ProcedurTurn

Seneca 15024

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	GA Ramp	2165	250	0	U	D	170	0
2	GA Ramp	2165	250	0	U	D	170	0
3	GA Ramp	2165	250	0	U	D	170	0
4	GA Ramp	2165	250	0	U	D	170	0
5	GA Ramp	2165	250	0	U	D	170	0
6	GA Ramp	2165	250	0	U	D	170	0
7	GA Ramp	2165	250	0	U	D	170	0
8	Delta	16	010	0	U	D	170	0
9	Turn to Alpha	16	260	10	U	D	170	0
10	Alpha	16	260	10	U	D	170	0
11	Alpha	16	260	10	U	D	170	0
12	End of Rwy 16	16	260	10	U	D	170	0
13	End of Rwy 16	16	260	10	U	D	170	0
14	End of Rwy 16	16	260	10	U	D	170	0
15	End of Rwy 16	16	190	10	U	D	170	0
16	Holding on 16	16	190	10	U	D	170	0
17	Taking Off	16	190	10	U	D	170	0

Time	Radio Traffic
0	
1	
2	
3	
4	
5	
6	
7	
8	Seneca 15024 – taxiing onto alpha for runway 16
9	
10	
11	
12	
13	
14	
15	Seneca 15024 – taxiing into position and holding on runway 16, Asheville
16	Seneca 15024 – departing runway 16 to the south

Cessna 9481U

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	Alpha	2165	340	10	U	D	170	0
1	Alpha	2165	340	10	U	D	170	0
2	Hold short rwy 16	2165	250	0	U	D	170	0
3	Holding on 16	2165	160	0	U	D	170	0
4	Taking Off 16	2265	160	75	U	D	170	0

Time	Radio Traffic
0	
1	
2	
3	
4	

Cessna
52679

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	Crosswind	2800	070	80	0	D	170	0
1	Crosswind	2900	070	80	0	D	170	0
2	Downwind	3165	340	100	0	D	170	0
3	Downwind	3165	340	100	10	D	170	0
4	Downwind	3000	340	100	10	D	170	0
5	Base	2600	250	85	20	D	170	0
6	Final	2400	160	65	30	D	170	0
7	Touchdown	2165	160	50	30	D	170	0
8	Rollout	2165	160	40	30	D	170	0
9	Rollout	2165	160	10	30	D	170	0
10	Papa	2165	205	0	30	D	170	0
11	Papa	2165	205	0	0	D	170	0
12	Alpha	2165	340	10	0	D	170	0
13	Alpha	2165	340	10	0	D	170	0
14	Alpha	2165	340	10	0	D	170	
15	GA Ramp	2165	070	0	0	D	170	

Time	Radio Traffic
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
18	
19	
20	

Mooney 11AE

Time	location	altitude(msl)	heading	speed	flaps	gear	wind - dir	wind - spd
0	GA Ramp	2165	250	0	0	D	170	0
1	GA Ramp	2165	250	0	0	D	170	0
2	GA Ramp	2165	250	0	0	D	170	0
3	GA Ramp	2165	250	0	0	D	170	0
4	GA Ramp	2165	250	0	0	D	170	0
5	GA Ramp	2165	250	0	0	D	170	0
6	GA Ramp	2165	250	0	0	D	170	0
7	Hold on Alpha	2165	340	0	0	D	170	
8	Hold on Alpha	2165	340	0	0	D	170	0
9	Hold on Alpha	2165	340	0	0	D	170	
10	Alpha	2165	340	10	0	D	170	
11	Alpha	2165	340	10	0	D	170	
12	Hold on Bravo	2165	250	0	0	D	170	
13	Hold on Bravo	2165	250	0	0	D	170	
14	Hold on Bravo	2165	250	0	0	D	170	
15	Hold on Bravo	2165	250	0	0	D	170	
16	Hold on Bravo	2165	250	0	0	D	170	
17	Taxing on 16	2165	160	10	0	D	170	
18	Taking Off 16	2165	160	75	0	D	170	
19	Upwind	2465	160	85	0	U	170	

Time	Radio Traffic
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	

Master Communication Log – SVS GA Scenario K

Aircraft Actions

ATC communications

Scripted Radio Calls from Other Aircraft

NASA 123 Radio Suggested Radio Calls

Time 0

Time 1

Cessna 52679 on crosswind
Cessna 9481U – Taxiing to runway 16 via alpha
[Approach]
NASA 123, proceed direct keans, cleared for ILS runway 16 approach, report procedure turn inbound
(Readback)

Time 2

Cessna 52679 turning crosswind to downwind
NASA 123 inbound to keans

Time 3

Cessna 9481U taxiing onto runway 16
Cessna 52679 on downwind
NASA 123 inbound to keans

Time 4

Cessna 9481U holding on runway 16
Cessna 52679 on mid-field downwind
NASA123 inbound to keans

Time 5

Cessna 9481U taking off
Cessna 52679 turning downwind to base
NASA 123 inbound to keans

Time 6

Cessna 52679 turning base to final
NASA 123 inbound to keans

Time 7

Cessna 52679 on final
NASA 123 over keans, proceeding outbound on final approach course

Time 8

Mooney 11AE taxi's on to alpha to runway 16 without making a call
Cessna 52679 touches down on runway 16
NASA 123 outbout on the final approach course

Time 9

Cessna 52679 slowing down on the runway and looking for a taxiway
Seneca 15024 – taxiing onto alpha for runway 16

Time 10

Cessna 52679 is now stopped on runway 16, trying to orient themselves
Mooney 11AE stops on alpha to allow Seneca 15024 to proceed
NASA 123 turns procedure turn outbound

Time 11

Cessna 52679 finds taxiway papa and clears runway 16
NASA 123 is turning procedure turn inbound
Seneca 15024 and Mooney 11AE continue on alpha

Time 12

Cessna 52679 is still on taxiway papa
Seneca 15024 holds short of the runway to complete run up
Mooney 11AE continues on alpha
NASA123 – Reporting procedure turn inbound
Roger NASA 123, tower is closed at Asheville, no traffic observed in the pattern, switch to Unicom 122.95

Time 13

Cessna 52679 taxiing on alpha to the ramp
Mooney 11AE holds short of runway 16 on bravo for run up
NASA 123 on final approach course inbound

Time 14

Cessna 52679 taxiing on alpha to the ramp
Seneca 15024 & Mooney 11AE still holding short
NASA 123 – Asheville Unicom, NASA 123 inbound ILS 16, 7 miles out

Time 15

Cessna 52679 taxiing on alpha to the ramp
Seneca 15024 & Mooney 11AE still holding short

NASA 123 continues on final approach course inbound

Time 16

Seneca 15024 – taxiing into position and holding on runway 16, Asheville
NASA 123 – Asheville Unicom, NASA 123, inbound on ILS runway 16, 5 miles out
Mooney 11AE continuing to hold short

Time 17

Seneca 15024 – departing runway 16 to the south
NASA 123 continues on final approach course inbound
Mooney 11AE continuing to hold short

Time 18

NASA 123 continues on final approach course inbound
Mooney 11AE taxi's into takeoff position on runway 16 and starts takeoff roll without a call

Time 19

NASA 123 touches down on runway 16 just as Mooney 11AE is approaching lift off speed

Time 20

NASA 123 on rollout
Mooney 11AE on upwind

Line Oriented Evaluation Scenario L

Terrain Avoidance Equivalent to VMC

SVS Aspects Tested: The following GA SVS CONOPS applications are tested in this scenario.

Approach

- A-5 Terrain Avoidance Equivalent to VMC

Time: 20 minutes

This scenario is taking place at Asheville Regional Airport, North Carolina. A general aviation aircraft is flying into Asheville from the northeast. The pilot is not communicating with anyone and is attempting to reach Asheville before a powerful cold front arrives from the northwest. As the scenario unfolds, the ceiling and visibility deteriorate, enveloping the pilot and inhibiting his ability to navigate visually. The local Sugarloaf Mountain VOR is below the aircraft's line of sight and useless to the pilot. Since the Class C airspace is also shutdown, the pilot cannot get any additional help. Note time index six where the pilot decides to turn 180 degrees in an attempt to get out of the bad weather – as general aviation pilots are taught in primary training. Unfortunately, the weather has deteriorated so rapidly that this maneuver only brings him face to face with a mountainside. The pilot continues to make turns to try to get out of this "box" and eventually makes his way to the airport—which he does not see until he is right on top of it.

Setting:
Time: 23:30 (tower has shut down, airport has reverted to an uncontrolled field)
Weather: See spreadsheet

SA Measurement

(1) Minimum clearance distance from the terrain (horizontal and vertical) on flight path should be calculated. Mean distance from optimal flight path should be calculated. Adherence to proper glide slope should be measured.

(2) SAGAT – The SA of the pilot should be measured via SAGAT queries at 3 different freeze points (at times 4.11, 11.45, 16.20). Queries should include:

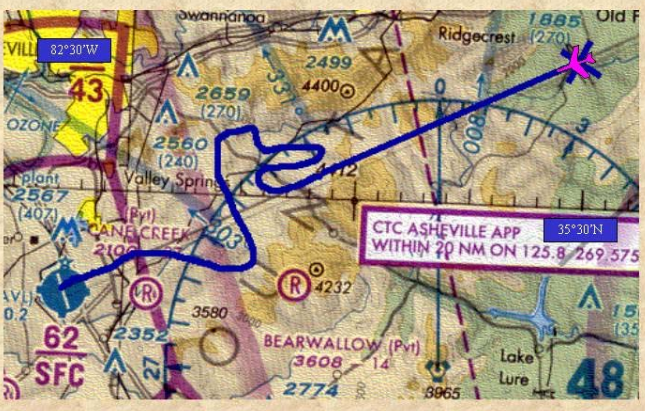
- Query 1 What is the current heading of your aircraft?
- Query 2 What is the current altitude of your aircraft?
- Query 3 What is the indicated airspeed of your aircraft?
- Query 4 What is the current rate of climb/descent of your aircraft?
- Query 5 What is the attitude of your aircraft (pitch and bank)?
- Query 7 How much fuel do you currently have?
- Query 8 What are the current winds (direction, magnitude, gusting to)?
- Query 15 Is there any conflicting traffic on your current (projected) flight path?
- Query 16 Conflicting traffic is currently located at (bearing and miles)?
- Query 17 Traffic conflict type
- Query 18 Is a change in path or altitude needed to avoid obstacles or terrain?
- Query 32 What is the range and bearing to the destination airport?

Scenarios for Assessing the Utility of Synthetic Visual Systems (SVS) in General Aviation Aircraft

Scenario I - Terrain Avoidance Equivalent to VMC

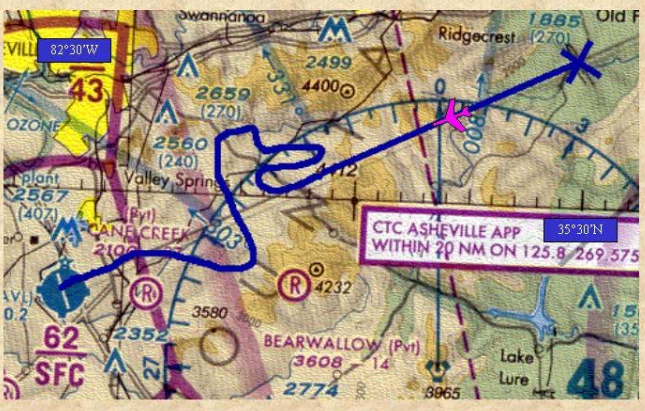
Asheville Airport – Scenario L

Time 1



Time 2

Time 3



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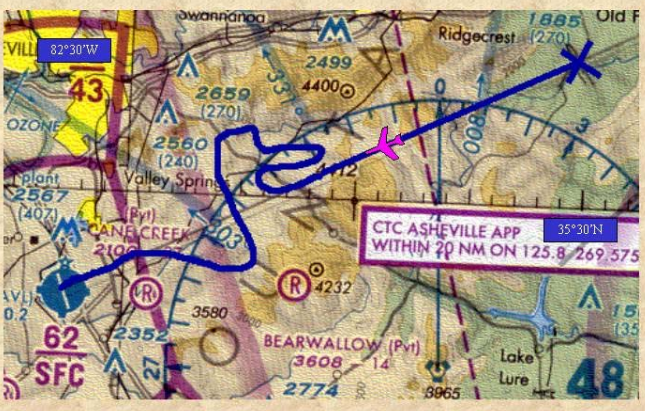
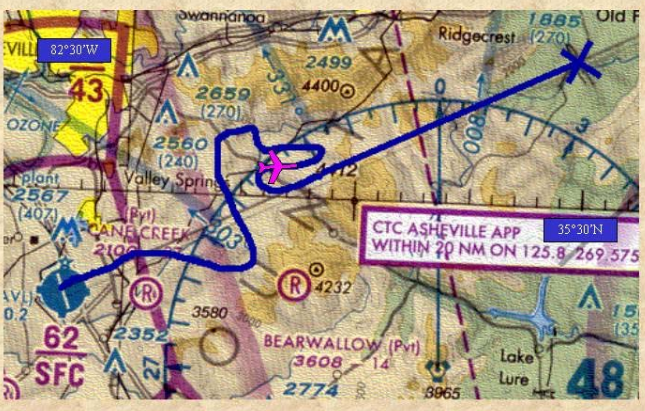


Time 5

Time 6

Time 7



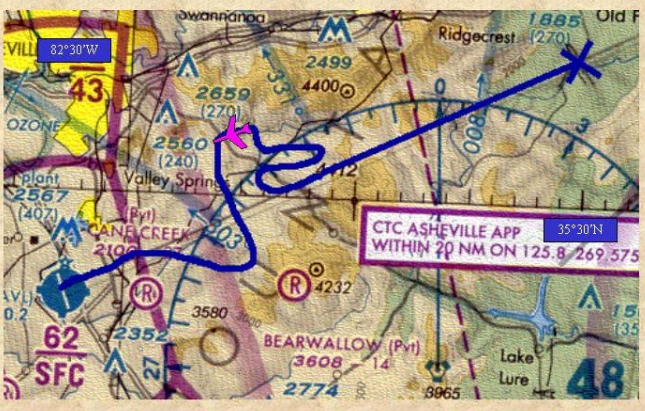
Time 8

Time 9

Time 10

Time 11

Time 12



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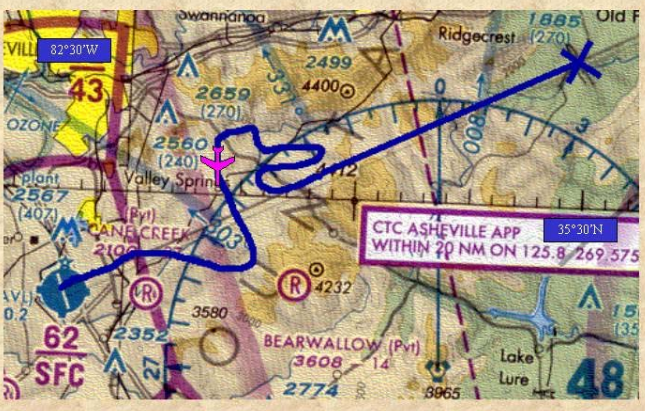
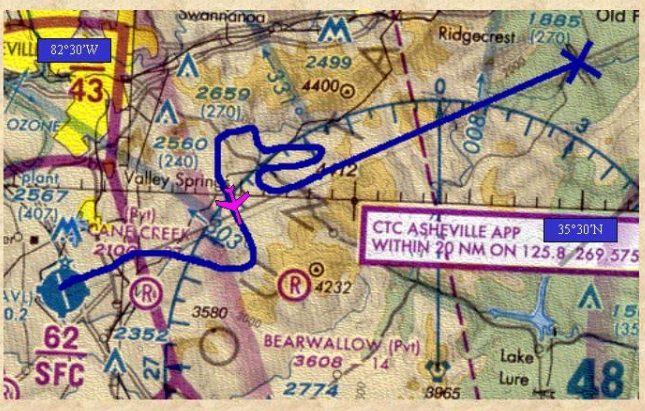


Time 14



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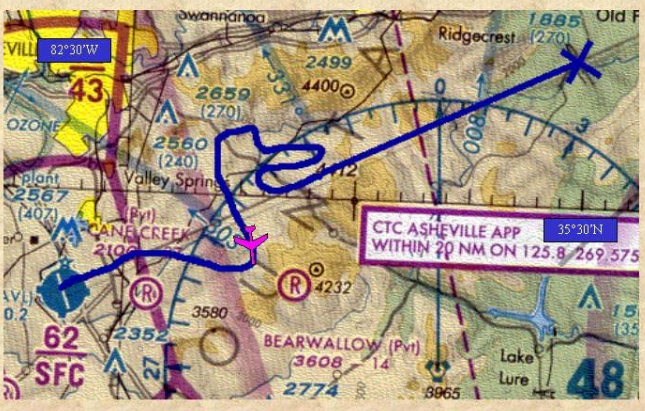
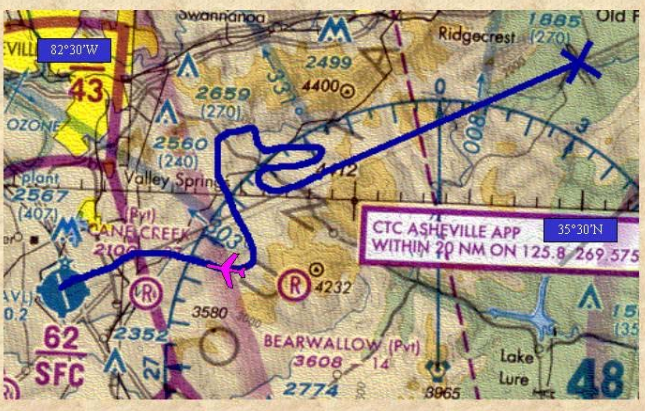


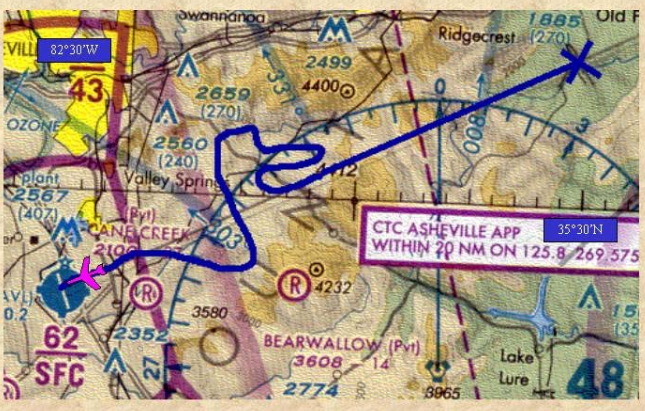
Time 16



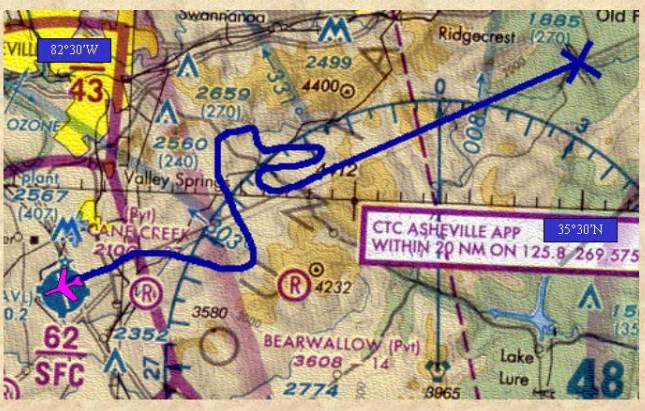
Time 17

Time 18

Time 19



Time 20


82°30'W
35°30'N
Ridgecrest
2499
4400
2659
(270)
2560
(240)
Valley Spring
2567
(402)
(Pvt)
CANE CREEK
210
203
CTC ASHEVILLE APP
WITHIN 20 NM ON 125.8 269.575
4232
3580
2352
62
SFC
BEARWALLOW (Pvt)
3608
14
2774
8965
Lake
Lure
48
43
1885
(270)

NASA123

Time	location	aircraft altitude(AGL)	ceiling (AGL)	vis(sm)	Mag Crs	speed	flaps	gear	wind - dir	wind - spd
1	35°35'N 82°15'W	2500	3500	5	250	120	U	U	170	0
2	35°34'N 82°13'W	2500	3000	4.5	250	120	U	U	170	0
3	35°33'N 82°16'W	2000	2500	4	250	120	U	U	170	0
4	35°32'N 82°19'W	1500	2000	2.5	250	120	U	U	170	0
5	35°30.5'N 82°22.5'W	1000	1500	2	250	120	U	U	170	0
6	35°30.5'N 82°24'W	800	1300	1	300	120	U	U	170	0
7	35°31'N 82°23.5'W	800	1300	1	70	120	U	U	170	0
8	35°31.5'N 82°21.5'W	800	1300	1	350	110	U	U	170	0
9	35°32'N 82°22.5'W	800	1300	1	260	100	U	U	170	0
10	35°32'N 82°24'W	800	1300	1	300	100	U	U	170	0
11	35°32'N 82°24.5'W	800	1300	1	340	100	U	U	170	0
12	35°32'N 82°25.5'W	800	1300	1	250	100	U	U	170	0
13	35°31'N 82°26'W	800	1300	1	200	100	U	U	170	0
14	35°29'N 82°25'W	800	1300	1	160	100	U	U	170	0
15	35°28.5'N 82°24.5'W	800	1300	1	165	100	U	U	170	0
16	35°27.5N 82°25.5'W	800	1300	1	280	100	U	D	170	0
17	35°28.5'N 82°27.5'W	800	1300	1	280	100	U	D	170	0
18	35°27.5'N 82°29.5'W	800	1300	1	250	100	U	D	170	0
19	35°26'N 82°31.5'W	800	1300	1	250	100	U	D	170	0
20	35°26'N 82°32.5'W	800	1300	1	250	100	U	D	170	0

Time	Radio Traffic
1	n/a
2	n/a
3	n/a
4	n/a
5	n/a
6	n/a
7	n/a
8	n/a
9	n/a
10	n/a
11	n/a
12	n/a
13	n/a
14	n/a
15	n/a
16	n/a
17	n/a
18	n/a
19	n/a
20	n/a

Master Event Log - GA Scenario L

This scenario is taking place at Asheville Regional Airport, North Carolina. A general aviation aircraft is flying into Asheville from the northeast. The pilot is not communicating with anyone and is attempting to reach Asheville before a powerful cold front arrives from the northwest. As the scenario unfolds, the ceiling and visibility deteriorate, enveloping the pilot and inhibiting his ability to navigate visually. The local Sugarloaf Mountain VOR is below the aircraft's line of sight and useless to the pilot. Since the Class C airspace is also shutdown, the pilot cannot get any additional help. Note time index six where the pilot decides to turn 180 degrees in an attempt to get out of the bad weather – as general aviation pilots are taught in primary training. Unfortunately, the weather has deteriorated so rapidly that this maneuver only brings him face to face with a mountainside. The pilot continues to make turns to try to get out of this "box" and eventually makes his way to the airport—which he does not see until he is right on top of it.

Setting:
Time: 23:30 (tower has shut down, airport has reverted to an uncontrolled field)
Weather: See spreadsheet SVS_GA_Scenario_L.xls

NOTE: See spreadsheet for specific altitude and heading data.

Time 1-4

Aircraft continues on 250 magnetic heading and descends to maintain VFR.

Time 5

Aircraft continues on 250 magnetic heading and passes mountaintop.

Time 6

Deteriorating ceiling and visibility cause the pilot to panic and attempt to turn 180 degrees to escape the situation.

Time 7

Pilot continues in opposite direction, but deteriorating conditions cause him to doubt his ability to climb over the terrain while maintaining VFR.

Time 8

Pilot turns 180 degrees again, hoping to find a way out to the west and north.

Time 9

Pilot continues westward, looking for a way out.

Time 10

Pilot assumes he is further west then he actually is and turns north to see if the mountains are there.

Time 11

Pilot notices rising terrain again.

Time 12

Pilot turns westward and spots more rising terrain immediately in front of him.

Time 13

Pilot turns southward to avoid terrain and tries to visually identify the railroad tracks.

Time 14

Pilot fails to find the railroad tracks and decides to continue in an attempt to escape southward, away from the approaching front.

Time 15

Pilot notices rising terrain again.

Time 16

Pilot decides to turn westward again, hoping to find Asheville Airport.

Time 17

Pilot finds railroad tracks and continues westward.

Time 18

Pilot finds the highway and railroad tracks.

Time 19

Pilot decides to continue on his heading, in the hopes that the airport is directly ahead.

Time 20

Pilot finds the airport.